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The Effects of a Single-Sex STEM Living and Learning Program on Female Undergraduates' Persistence

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ABSTRACT
Fewer women choose to stay in science, technology, engineering, and mathematics (STEM) majors. This decision-making process is influenced by a variety of external factors (parental support, success in science and math classes) and internal factors (reactions to grades, identifying with perceptions of STEM professionals). This study focuses on women's internalizations and the influences of one specific external factor – a single-sex program aimed at sustaining STEM persistence at the university level. This study used a narrative life history methodology to examine the influences that a single-sex program at a United States university had on twenty-six undergraduate women's STEM career choices. The study examined the criticisms aimed at single-sex programs (increase stereotypes, provide programming that is separate and not equal). The results of the study did not support these criticisms. However, the findings also did not unequivocally demonstrate the positive impacts of single-sex programs on the persistence of women in university-level STEM programs. The results highlight how women's persistence in STEM programs is related to the identity negotiations they undergo and the support networks they find, both of which are affected by the culture of STEM departments.

KEYWORDS
Single-sex programs, women undergraduates, STEM persistence, gender

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SINGLE-SEX PROGRAMS: A NEW SPIN ON TITLE IX

Historically, fewer women in the U.S. compared to men choose to pursue science, technology, engineering, and mathematics (STEM[1]) majors and fewer still persist in those majors through graduation (AAUW, 2010; National Science Foundation [NSF], 2011). Although biology and chemistry have a strong representation of women at the university level, the persistence of these women into graduate school and faculty positions is less than 40% (NSF, 2011). Both male and female students go through similar steps in their decisions to pursue careers based on their expectations of success and the value they place on that success (Eccles, 2007). However, for women in most STEM disciplines, this decision-making process is influenced by their gender (Eccles, 2013). In the US, women are underrepresented as faculty members in all STEM disciplines, which lead to fewer role models for younger women to encounter. Socializers (parents, teachers) tend to support male students in fields such as engineering and physics due to the masculine stereotype (and reality) of these fields (Farmer, 1997; Williams & Ceci, 2007). Researchers highlight the role of both the external factors (parental support, success in science and math classes) and internal factors (reactions to grades, identifying with perceptions of STEM professionals) that affect women's STEM career decisions differently than men.

In the United States, a number of policies have been put in place over the last decade to attempt to improve U.S. female citizen's representation in STEM fields. Most of these policies stem from Title IX of the 1972 Educational Amendment Act[2], which holds organizations receiving federal funding accountable for the equitable representation of women in various programs (Carpenter & Acosta, 2005). Most Americans associate this policy and its enforcement with athletics, but the policy has been implemented in academic departments as well (National Science Foundation, 2011; Salamone, 2003). One specific policy initiative that has stemmed from this response has been the creation of single-sex[3] programs – a response that has come under fire by some feminist organizations (e.g., AAUW, 2009). This study focuses on the influence of one such single-sex program on university women's decisions to pursue a STEM degree within a broader co-educational environment by focusing on: women's perspectives of their chosen STEM fields; their expectations of success in these fields; and the value they place on this success. Previous studies have suggested that to gain a more informed understanding of single-sex programs and their influences, it is necessary to qualitatively examine how participation in various programs influences women's persistence in STEM fields (Farmer, 1997; Seymour & Hewitt, 1997). Therefore, to understand these factors, this study used a narrative life history methodology to examine the influences that affect undergraduate women's choices to stay or leave. Two research questions guided this study:

How did participation in a single-sex living and learning STEM program affect women's decisions to persist in STEM majors and fields?
How did the influences on these women compare to those on women STEM majors from the general SU student population?

The Issues for Women in STEM
Title IX has been implemented in U.S. universities' STEM departments since 1972. However, it gained media attention in 2000 (Ferrara & Ferrara, 2008; Spielhagen, 2008). With the help of Title IX, women's representation in undergraduate degrees has improved even in the last decade: in 2006, women represented 39% of all STEM bachelor's degrees compared to less than one-third in 2000 (NSF, 2011). However, the gender gap increases as students move on to graduate school. In 2006, women represented 32% of all STEM masters and PhD degrees. In 2008, women represented less than 25% of the STEM workforce. These statistics demonstrate how women are continuously lost at each point in their STEM education (NSF, 2011), particularly when one considers that women represent 50% of the United States population (US Census Bureau, 2010). This significant difference between the women as a proportion of the U.S. population and women as a proportion in STEM careers indicates a broader problem.

With Title IX as a basis, the U.S. government and many university administrators have created programs and policies to address the underrepresentation of women in STEM fields. Table 1 provides evidence for the success of these programs in chemistry and biological sciences across all degree levels. Many programs that utilize Title IX in STEM departments have been based on the rationale that increasing women's access to STEM programs, careers, and role models beginning in elementary school and continuing into college and graduate school will increase their representation in these fields (Rolison, 2003; Rosser, 2003). Despite this increase in access, the number of women entering STEM careers and persisting in these careers has not improved significantly across all disciplines (physics and engineering) and at all levels (undergraduate to graduate degrees). One reason for this is that these access policies ignore the culture of various STEM fields – white, male, and middle class – that continues to prevent women from fully identifying with and persisting in these careers (Brotman & Moore, 2008; Ong, 2005). (The fields represented in Table 1 were chosen because they represent the original majors of the participants in the study[4].)

Table 1: Percent of Female Graduates in Specific STEM fields in 2010

	Physics*	Engineering**	Biological Science**	Chemistry**
Bachelor's degrees	21%	22%	58%	49%
Master's degrees	22%	24%	56%	48%
Doctoral degrees	19%	22%	52%	37%

(American Institute of Physics, 2012)
**(National Science Foundation, 2011)*

The underrepresentation of women in certain STEM fields begins as early as elementary school. Socializers, including parents, teachers, and guidance counselors, play a major role in students' career choices during the elementary and secondary school years. These socializers often provide more support, whether implicitly or explicitly, for males than females in the stereotypical male-centric fields of STEM (Carlone, 2004; Dick & Rallis, 1991; Farmer, 1997; Jones et al., 2000; Mau, 2003; Nosek, Banaji, & Greenwald, 2002; Olitsky, 2006; Sadker, Sadker, & Zittleman, 2009; Zohar & Bronshtein, 2005). This lack of support leads many young women to lose interest in STEM (seeing it as an inappropriate career option) and/or to fail to take the necessary courses that will prepare them for a STEM major at the university level – leading many women to enter higher education with no interest in or poor preparation for STEM courses.

Women, who do enter university with an interest in STEM and the necessary preparation for success in STEM, then encounter a sense of marginalization due to the chilly climate within many STEM departments (Hall & Sandler, 1982; Leggon, 2006; Seymour & Hewitt, 1997; Shakeshaft, 1995). The chilly climate is based on gendered and non-gendered issues within STEM departments. The gendered issues include the sense of isolation women feel when they find themselves outnumbered by their male peers in their science courses (Leggon, 2006). These women also encounter few female role models and professors within their STEM departments (Leggon, 2006). The male-centric culture within these departments enhances the sense of isolation (Lemke, 2001; Olitsky, 2006), and this can prevent women from excelling in STEM (Jones et al., 2000; Olitsky, 2006; Ong, 2005). Female students are often forced to make a decision whether to maintain their individual identity (composed of cultural, gender, and other influences) or to join the science community where there has been historical marginalization for women and minorities (Leslie, McClure, & Oaxaca, 1998).

The isolation that women feel as minorities within certain STEM majors at the college level and beyond is compounded by the non-gendered aspects of the chilly climate including the weed-out system used by many of these departments. The weed-out system refers to large courses that are purposely designed to be difficult so that most students will fail without an adjustment of assessment measures (Seymour & Hewitt, 1997). Research suggests that women tend to internalize grades as representations of their overall abilities, whereas men tend to see them as baseline measurements (AAUW, 2010; Farmer, 1997; Williams & Ceci, 2007). As a result, more women than men tend to be dissuaded by the poor grades they receive in weed-out courses leading more women to doubt their abilities to succeed in their chosen STEM major and/or to lose interest in the subject (Carlone, 2004; Duschl, Schweingruber, & Shouse, 2007; Farmer, 1997; Ferenga & Joyce, 1998). Consequently, the combination of a perceived chilly climate and women's reaction to this climate affects women's ability to identify with the field, thereby leading women to leave STEM fields (Brickhouse & Potter, 2001; Jorgenson, 2002).

Policy Response: Title IX

The federal government's current interest in addressing the underrepresentation of women in STEM fields relates to economic and environmental security in the United States (Chang, 2009; Tessler, 2008). STEM fields not only pay their practitioners well, but they also bring in revenue for successful businesses and governments (National Science Board, 2008). The United States is beginning to lose larger numbers of the scientists trained in American universities. In 2005, American citizens earned only 49% of all the STEM doctorates awarded that year with women representing only one-third of these degrees (National Science Board, 2008). Although in previous decades many of the non-American citizens stayed in the United States to work and live, now larger numbers of these scientists are returning to their native countries because these countries have the means to support STEM professionals.

Although researchers, educators, and policy makers agree that more women and minorities are needed in STEM fields, there has been no consensus regarding the best way to attract and retain these groups (Mael, Alonso, Gibson, Rogers, & Smith, 2005). One strategy that the American government, universities, and industries have used to increase the number of U.S. citizens majoring in and completing STEM degrees is to focus on increasing the access of minority groups (including women) to these majors through efforts that fall under the requirements of Title IX.[5] One popular but controversial policy approach has been the implementation of single-sex programs aimed at advancing the networking capabilities, confidence, and interest in STEM for women and girls (Gandy, 2006; Spielhagen, 2008). The use of single-sex programs as a policy initiative has been met with suspicion by many U.S. women's organizations including the National Association of Women (NOW) and the American Association of University Women (AAUW), who believe that these types of programs are detrimental because they promote a separate but equal system of education that is often not equal for women (AAUW, 2009; Gandy, 2006). These organizations also feel that these single-sex programs are in violation of the original anti-gender discrimination goals of Title IX. Despite these concerns, single-sex programs have increased at both the K-12 and higher education levels (Spielhagen, 2008).

The Intervention: STEM-focused Single-Sex Living and Learning Communities

One type of single-sex initiative that has gained prominence at the university level are single-sex STEM living and learning communities (LLCs). In the last two decades, more than twenty-five colleges and universities across the United States have instituted single-sex STEM LLCs to provide support and increase retention for undergraduate women in STEM majors (Inkelas, Johnson, Alvarez, & Lee, 2005; Inkelas, Szelenyi, Soldner, & Brower, 2007). The rationale for these programs is to provide women with a female-friendly environment where they can be exposed to female peers and role models who can challenge the stereotypes of STEM as male-centric or simply provide a supportive network that will allow them to persist. According to researchers, LLCs can help students combine their social and educational worlds and increase the likelihood that students will remain in a particular field or institution (Tinto, 1997).

Although these programs vary among campuses, each program possesses common characteristics: participants live together in a residence hall and engage in common social and educational activities; participants receive academic and social support. Further, each program is supported financially by its respective university, its department, donations, or outside funding (such as the National Science Foundation in the United States). Because these programs have emerged in the last two decades, few researchers have had the opportunity to study them and their effects on women's STEM career choices and the retention of women in STEM fields. National studies and survey instruments merely scratch the surface of the underlying cultural, social, and individual influences that affect women's STEM career decisions (AAUW, 2010; Inkelas et al., 2007). Other research has provided mixed evidence regarding whether single-sex programs and policies improve the retention and performance of women in STEM fields (Inkelas et al., 2007; Mael et al., 2005).

Inkelas et al. (2007) conducted the first national study of women-only STEM LLCs that included survey responses from over 22,000 students at forty US universities in 2004 and 2007. The study compared women in women-only STEM LLC programs to women in coeducational STEM LLC programs, women in non-STEM LLC programs, and women in traditional residence halls to see if there were differences in STEM persistence, interest, and career choice across the groups. The comparison of the survey responses showed mixed results regarding the effects of LLCs on women's persistence in STEM fields. The study did find positive effects of women-only and coeducational STEM LLC programs on women's confidence in STEM fields. One limitation to this study was that the participants were all first- and second-year students, with the majority being first-year students (Inkelas et al., 2007) who did not have sufficient time and experience to reflect on the impact of the STEM LLC on their interest and persistence in the field.

Most studies on single-sex STEM LLCs focus on individual programs (Allen, 1999; Brainard & Carlin, 1998; Kahveci, Southerland, & Gilmer, 2006; Kahveci, Southerland, & Gilmer, 2007), and three of these studies used only survey instruments to measure influences on participants' persistence. The survey results indicate that all students – whether or not they participated in a LLC – showed a decrease in confidence in their abilities over the time period that these were measured (Allen 1999; Brainard & Carlin, 1998; Kahveci et al., 2006). Brainard and Carlin (1998) surveyed participants in a single-sex STEM LLC at the University of Washington each year they attended the university. Allen (1999) compared participants in a single-sex STEM LLC program at the University of Wisconsin to female students from the general population who were majoring in STEM. And Kahveci, Southerland, and Gilmer (2006) compared participants in a single-sex STEM LLC at a university in the southeast to male and female STEM majors from the general population. Brainard and Carlin's study and Allen's study found that all of their participants cited barriers to their persistence such as poor teaching, low grades, lack of female role models, and unapproachable faculty, which led to a decrease in confidence in their abilities. Leavers were more affected, experiencing lower levels of confidence in their math and science abilities despite there being no difference in their grades (Brainard & Carlin, 1998; Allen,1999). This demonstrates the role that identity and its various components (self-confidence/self-efficacy, performance of abilities, and recognition for this performance) play in STEM persistence (Carlone & Johnson, 2007).

Kahveci, Southerland, and Gilmer (2006) showed significant positive differences in persistence for the LLC females. This cohort had the highest levels of persistence over a semester. The females in the non-LLC cohort had the lowest levels of persistence. Yet, the authors were not able fully to show why or how this difference in retention rates occurred. To address this limitation, Kahveci, Southerland, and Gilmer (2007) published a study on the qualitative portion of their previous quantitative study (Kahveci et al., 2006). In the qualitative study (Kahveci et al., 2007), the authors conducted a two-and-a-half year case study on three women who had participated in one particular single-sex STEM LLC. The three case-study participants described the benefits of the sense of community and support they received, specifically highlighting the positive role of the peer leaders (third and fourth year LLC participants who volunteered to live on the same floor in the hall of residence to provide mentoring to the first-year students). The authors indicated the importance of a peer support network on women's choices to remain in STEM fields and showed how the specific program in this study (peer leaders) was different from other single-sex LLC programs. These differences can influence the effects of each program on the participants' STEM major decisions. Although each program is different, studying the effects of these individual programs on persistence is important to create a series of best practices. This study reveals the importance of interviews for learning more about the participants.

These studies illustrated the positive influences of women-only STEM LLCs; however, they do have some limitations that my study aims to improve upon. First, Allen (1999) and both of Kahveci et al.'s studies (2006, 2007) only focused on first- and second-year students. Studies have shown that retention rates of female STEM majors tend to decrease later in college after they have been exposed to both the chilly climate and the effects of the weed-out system (Leggon, 2006; Seymour & Hewitt, 1997). Therefore, in my study, I focused on women in their final year of university so that they would have more experiences within their major and could better reflect on the role these experiences had on their persistence. Another limitation is that most of these studies focused on survey results (Allen, 1999; Brainard & Carlin, 1998; Kahveci et al., 2006) or a limited number of cases (Kahveci et al., 2007). Previous studies have shown how important interviews can be in understanding participants' rationale for STEM career decisions (Bianichini et al., 2000; Farmer, 1997). Consequently, my study focused on the narrative life histories of twenty-six women as it applied to their interest and persistence in STEM.

CONCEPTUAL FRAMEWORK

The studies referenced above point to some of the cultural and social issues and the individual interpretations and reactions to these issues that affect women's persistence in STEM. Eccles' expectancy value model for career choice (2007) accounts for all of these issues as well. The cultural concepts include the influence of gender roles, cultural stereotypes, socializers, and achievement in science and mathematics classes. The interpretations of these various concepts, including stereotypes, can shape individuals' goals and decisions. These cultural influences, combined with an individual's perceptions and experiences, culminate in the final two parts of the expectancy-value model: expectation of success and the value a person attaches to this success (Eccles, 2007). According to Eccles, one's expectation of success is influenced by one's confidence in his or her abilities. This confidence level is also affected by the estimated difficulty of the tasks required for a STEM career. An individual's beliefs regarding his or her abilities are influenced by that individual's performance in science and mathematics courses and by the support he or she receives from socializers (Carlone, 2004; Rayman and Brett, 1995). Eccles (2007) identified four types of value that each individual assesses to make a career choice: (a) *attainment value* indicates how well the career fits with one's identity; (b) *intrinsic value* is the interest or enjoyment derived from a career; (c) *utility value* indicates how well the career fits with current and future goals; and (d) *cost* refers to the negative aspects perceived to be associated with the career.

The increase in single-sex programming at the college level has been driven by access policies (commonly supported by liberal feminists), which are based on the assumption that if women are given access to STEM programs, their numbers will increase (Brotman & Moore, 2008; Kinser, 2004). However, the data demonstrate that this is not the case since women's representation in certain STEM fields – physics, engineering, and computer science – has remained stagnant over the last decade, despite increased access. One explanation for these differences in female STEM retention in each discipline is often credited to the role that STEM identity plays. Women and minorities in STEM are often unable to fully identify with the culture of STEM programs, and this culture is addressed by access policies.

To improve Eccles' framework I incorporated current STEM identity theories in the conceptual framework for this study (Carlone, 2004; Carlone & Johnson, 2007). According to Carlone and Johnson, gender is just one aspect of one's identity that can evolve as individuals move through various experiences. Viewing gender in this way demonstrates the complexity of STEM career decisions (and the role that single-sex programs can have on these decisions) in that these decisions involve gender and broader identity agreement. Carlone and Johnson build on the idea of STEM identity by explaining that one's identification with a career is impacted by individual experiences and interpretations, specifically self-efficacy, opportunities to demonstrate abilities, and recognition of these abilities from credible others.

Second-wave feminist theories tend to promote a common female experience which is not the reality, particularly in STEM (Kinser, 2004). Consequently, the role of the individual female is highlighted through the use of interviews (narrative life histories) which focus on the individual experiences of the participants in this study at various phases in their lives – eventually leading to a career choice.

METHODS, SETTING/CONTEXT, AND DATA COLLECTION

The participants in this study were students at a large university (State University SU). Half of the participants were part of a single-sex STEM LLC, the Women in Science, Technology, Engineering, and Mathematics program (WSTEM). (The breakdown of these participants and their participation in the LLC can be found in Table 2). The study focused on the role this program played in female college seniors' persistence in STEM as measured by college majors and career goals. To better understand the decision to create the WSTEM program and its programming choices, I interviewed the previous director and the current director of the program. The undergraduate participants for this study included twenty six women who attended SU from 2006 to 2010. Pseudonyms have been used for all participants. Twelve of these women had participated in WSTEM and fourteen came from the general SU student population. All twenty-six women were interviewed using narrative life history analysis to understand the influences – including WSTEM participation – on their decisions to stay in or leave their original STEM major (Creswell, 1998). At the time of graduation fourteen of these women (eight from the general population and six from WSTEM) graduated with a STEM degree (stayers) and planned to pursue a STEM career and twelve chose to leave (leavers) their original STEM major and did not plan to pursue a STEM career (six from the general SU student population and six from WSTEM). (See Appendix A for more detail on the categorization of stayers and leavers.)

Table 2: Cohorts of participants.

Cohort	Description
WSTEM Stayers (N = 6)	Women who participated in WSTEM and remained in a STEM major
WSTEM Leavers (N = 6)	Women who participated in WSTEM and left the STEM major
Non-WSTEM Stayers (N=8)	Women from the general population who did not participate in WSTEM, who remained in their STEM major
Non-WSTEM Leavers (N=6)	Women from the general population who did not participate in WSTEM, who left their STEM major

Participants

All twenty-six participants were declared STEM majors when they entered SU as first-year college students in the autumn of 2006. All were also recipients of the state's merit-based scholarship, which covers 75% to 100% of tuition each semester. The award is based on high school students' grades and standardized test scores. Because all the participants received merit-based scholarships, it makes the comparison of participants from different groups similar in that both the

WSTEM participants and the non-WSTEM participants (as well as both leavers and stayers) had similar high school grades and standardized test scores.

State University

State University had a population of approximately 40,000 students from 2006 to 2010, the period when this study took place. Of these enrolled students, 76% were undergraduates. During the period of this study, STEM majors comprised 15% of the total undergraduate enrollment, and women represented less than one-third of these students (Vice President of Undergraduate Affairs at State University, personal communication, November, 1, 2010). The STEM persistence rate for women who entered State University in the fall of 2006 and graduated in the spring/summer of 2010 was 50%, where 613 women enrolled as STEM majors as first-year students in 2006 and 309 remained in STEM majors (Vice President of Undergraduate Affairs at State University, personal communication, August 31, 2010).

The number of female faculty in each of the STEM departments at SU for the 2009-2010 school year matched the national averages of female faculty in STEM departments as calculated by the NSF (2011). The 2009-2010 school year was chosen because this was also the estimated graduation year for the undergraduate participants. Similar to national statistics, the department with the highest representation of female faculty was Biology with 29% women (NSF, 2011). The lowest representation of female faculty at State University was in the Electrical and Computer Engineering Department, where there was only one female faculty member out of 20. This department was closely followed by the Physics Department (7%) and the Chemical and Biomedical Engineering Department (7%). SU is an adequate representation for the national issues of women's underrepresentation in STEM fields, because it mirrored national statistics for female faculty percentages. None of these percentages matched Madill et al.'s (2007) definition of critical mass, which is 30%.

WSTEM Program

The Women in Science, Technology, Engineering, and Mathematics (WSTEM) program began in 2000 at State University with an average of thirty-six participants per year. Since 2000, the stated mission of the program has been to increase the retention of women in STEM fields. I focused on a cohort of WSTEM participants who entered State University during the autumn of 2006. At this point the WSTEM program had been in existence for six years, which ensured that the program had reached a point where the experiences provided from one year to another were similar and had been evaluated by the program director (Personal communication with current Director, October 8, 2008; Personal communication with previous Director, July 15, 2008). This evaluation process ensured that the program activities that remained from year to year were the most influential and successful for participants' persistence in STEM fields based on six years of program evaluation (Personal communication with current Director, October 8, 2007).

WSTEM, like other women-only STEM LLCs, is a program in which college women who are typically first-year students live together with other women who have declared a STEM major. Acceptance into this program is based on each individual's expressed interest in a STEM major and her reasons for this interest. The program director and the graduate assistant who work with the program review applications and purposefully pick students who show an interest in research careers in STEM fields. First-year WSTEM members participate in a required one-credit weekly course, which includes the following: presentations by guest speakers (scientists in different STEM fields); readings or assignments related to women in STEM fields; discussions of current topics in STEM fields; and visits to local laboratories and facilities associated with SU. The students are encouraged to become involved in research opportunities with professors on campus whom they meet during their laboratory tours or in their classes. WSTEM pays participants an hourly wage for their research appointments. After the first year, students are welcome to continue to be part of the WSTEM program, including participation in any of the semester activities and the paid research opportunities as long as they are still majoring in a STEM discipline.

Data Collection

After the WSTEM program was identified as the program of study, I began to determine the parameters for the participants. The research question asked how participation in a women-only STEM LLC (WSTEM) affected participants' STEM career decisions. To explore this question, fourteen women from the general SU student population who had chosen a STEM major as incoming students in 2006 were compared to twelve participants who had participated in WSTEM as first-year students. These cohorts were further divided into stayers and leavers. As a result, there were four distinct cohorts of individuals in this study, which are highlighted in Table 2.

WSTEM participants. Once the Human Subjects committee had given consent to my study in 2008, I contacted the WSTEM director to request the names of the first year WSTEM participants for the 2006–2007 school year. That cohort consisted of thirty-eight women who lived on the WSTEM floor and participated in the one-credit course for first-year students. For this particular WSTEM cohort, there was a 55% retention rate for women in STEM majors. (The University's STEM retention rate for first time female college students (including WSTEM members) was 50%). Twelve of the original thirty-eight agreed to participate in my study.

Non-WSTEM participants. During the interviews with each of the WSTEM participants, snowball sampling methods were used (Creswell, 1998) to find the names of women whom the participants knew in their own STEM majors and could recommend. Fifteen names were revealed through the sampling methods. Snowball sampling methods were chosen to ensure that that the majors of the WSTEM stayers would correspond to the majors of the non-WSTEM stayers (Creswell, 1998). Of the fifteen identified non-WSTEM stayers, eight students agreed to participate in the interview.

Non-WSTEM leavers. The snowball sampling methods did not yield any results for non-WSTEM leavers. Although eight individuals were identified, none of these women responded to monthly emails sent from May to August asking if they would be willing to participate in the study. In August 2009, I contacted the Dean of undergraduate studies at SU. The Dean emailed my recruitment letter to the 304 individuals who had originally declared a STEM major during their first year at SU (2006-2007 school year) and had subsequently switched to a non-STEM major. Six women responded as willing to participate to the interview.

Sources of Data

The primary sources of data were two semi-structured interviews with each participant during the 2009-2010 school year. For the WSTEM participants, I also had their permission to review their original applications to the program. The first set of interview questions was developed to obtain the life histories of each participant. (For a full list of interview questions, please contact the author). Drawing on the conceptual framework for this study (Carlone & Johnson, 2007; Eccles, 2007), a narrative history storyline was created for each participant to highlight the consecutive phases of their life and the transitions between them: childhood, middle and high school, and college. During the narrative life history interviews, the focus was on specific incidents that contributed to each individual's interest in STEM fields (or lack thereof) and decisions as they relate to STEM fields. Each participant had her own storyline and accompanying map, which allowed for easier cross-case comparison to identify the similarities and differences among individuals and their career-choice decision paths. The resulting interview transcription and storyline map were sent to each participant for verification and member checking (Creswell, 1998). These first interviews were conducted in person in a graduate research assistantship office on the campus. The average interview length was sixty minutes.

The second set of interviews occurred during the spring of 2010 to identify whether any of the participants' career choices or plans had changed as they approached their graduation from college. These interviews served as a source of validation and triangulation by identifying whether individuals were still part of their original leaver or stayer cohort and what each person's plans were after graduation. These interviews were conducted via email correspondence.

Although interview data, particularly life histories, are based on individual perceptions, these perceptions are commonly considered the factors that affect women's STEM career decisions; therefore, it was important to this research that the participants provided detailed descriptions of their perceptions. These perceptions were unique to each person and impacted participants' decisions to stay or leave their STEM major. Consequently, the reality – which may or may not have differed from each person's perception – was not as important as the perception of these events.

Data Analysis

Data analysis occurred at the same time as data collection. After transcribing each interview, I reviewed the interview and the notes and combined the documents into memos for each participant (Creswell, 1998). The memos served as the source for each participant's corresponding storyline, which was based on the original themes and factors identified in the literature review and conceptual framework. These themes included each individual's perception of gender roles, personal identity, the influence of socializers and role models, their own science practice and preparation, future family plans, chilly climate, policy issues related to women in STEM, expectations for success in STEM career, and value of success in STEM career. After all of the interviews were completed, I conducted within-group analysis and studied each life history to identify common themes among stayers and leavers (Strauss & Corbin, 1990). Data displays and thematic memos were created for the two groups to summarize the common themes, highlight specific cases, and relate the data from this study to the literature. The themes from each group were compared via across-group analyses and included data displays with thematic memos to summarize themes (Strauss & Corbin, 1990).

RESULTS

All of these young women were successful students whose abilities were recognized by respected others (e.g., teachers) before entering college. Their sense of STEM identity was relatively strong in that they wanted to pursue a STEM degree and eventual career when they entered SU (Carlone & Johnson, 2007). Each of these women had an expectation of success in their chosen field and saw value in the pursuit of this field when they entered SU (Eccles, 2007). However, as these women moved through their courses and experiences within SU and their respective STEM departments, their interest in, expectations of success in, value placed on, and identity with STEM began to evolve as evidenced by their storylines.

First, the comparison of the storylines for stayers and leavers demonstrated some clear differences in motivation for choosing a STEM major. Ten stayers were motivated by their intrinsic interest in the subject whereas only two leavers described this as their motivation. In comparison, four stayers were motivated to choose their STEM major for the intrinsic desire to help others compared to six leavers. The leavers also reported this motivation as a reason for their decision to leave. Once these leavers learned more about their chosen STEM career in college, they began to question their motivation. For example, Nella, a WSTEM Leaver discussed how her chemistry major no longer felt like a field where she could help others: "I just want to help people a lot and I feel that I can make a difference in psych[ology] as opposed to chem[istry] by working with people, not chemicals." Only leavers cited extrinsic interests (e.g., making money) as part of their motivation for originally choosing their STEM major. These motivations influenced the value each woman put on her success in STEM and her level of identification with the chosen STEM field. As Nella indicated, she no longer identified with chemistry and did not see the value in pursuing that degree, but could see value in and identify with the career options presented by a degree in psychology (Carlone & Johnson, 2007; Eccles, 2007).

Second, there were clear differences in the stayers' and leavers' reactions to the chilly climate. (For more details on this result, please see Hughes, 2012). All but two stayers described aspects of the chilly climate in their STEM course (e.g., low grades, sense of isolation as the only woman in their class, and lack of help from faculty). The stayers appeared to view negative experiences, such as poor grades, as a source of frustration but not as an indication that they could not succeed in a STEM major or career. Many of these women were motivated to succeed by aspects of the chilly climate (e.g., male-dominated class sizes, poor grades, weed-out courses). Claire, a WSTEM Stayer, described her reaction to the long hours of studying she had to complete in engineering: "You have to have a certain, I guess, drive and you have to know you're not going to be right all the time; it's not going to be easy." Julie, a non-WSTEM Stayer, described the sense of motivation she derived from her male-dominated major: "There definitely are a lot more males. I don't find that disheartening or discouraging at all. I almost find it more empowering." The leavers interpreted their experiences as reasons to leave. For example, Renee – a WSTEM Leaver – described her reaction to the long hours of studying:

> I just felt like I couldn't hack it. Because I had no desire to pore over my books for 5 hours a day and everybody else did. Everybody else was willing to do that, and I kind of wanted to go out and do other things.

The stayers were able to maintain their STEM identity because of intrinsic motivations for the subject as opposed to extrinsic motivations (e.g., making money or helping others) that many of the leavers cited (Hughes, 2012

In terms of the gendered aspects of the chilly climate, all of the participants recognized the underrepresentation of women in their chosen STEM field. The stayers saw this underrepresentation as a source of motivation. These women thought their differences and minority statuses made them stand out in a positive way. They believed that women could succeed so long as they had equal access. They did not question the social capital that men might have in the STEM fields. The leavers in this study believed in gender stereotypes and/or saw themselves as more feminine than the typical STEM professional. These women were marginalized in their original STEM majors because of their perception of the dominant discourse as masculine. Seely – a non-WSTEM Leaver – discussed the "old boys system" that she observed as a science major. "All the science directors are male. I can't even imagine if I was a female scientist at [SU] and 95% of my colleagues are male, who is my role model at [SU]?" Similarly, Renee (a WSTEM Leaver) said that "I still feel like women are looked at like we can't do as much as men can." These young women were unable to see themselves identifying with these fields or they did not see the value in these fields because of their lack of identity with them (Hughes, 2012). The general comparison between leavers and stayers highlights the roles of identity, expectation of success, and value of success in these participants' STEM persistence (Carlone & Johnson, 2007; Eccles, 2007). The next section identifies specifically how an access policy – single-sex STEM LLC – influenced the WSTEM participants' interest and persistence in STEM compared to those women who did not participate.

The Positive Aspects of WSTEM

Quantitatively speaking, WSTEM did not have a significant effect on the participants' persistence rate compared to the persistence rate of the general population – 55% versus 50% respectively. Despite this result, there were impacts that were mentioned by stayers and leavers who participated in WSTEM that are important to research, particularly the continued existence of the chilly climate within STEM departments and the inadequate reach of access policies to a variety of women and their individual identities. Therefore, it is worthwhile to explore these results.

The first difference that was apparent between the WSTEM stayers and leavers is their motivations for joining WSTEM. The six stayers were motivated by academic STEM-related reasons. All six stayers mentioned either a desire to live with like-minded women or the availability of STEM research opportunities among their reasons for joining WSTEM, whereas half of the leavers were motivated by extrinsic reasons unrelated to STEM, like living in nicer dorms. These reasons indicate that more stayers were motivated by intrinsic STEM interests than leavers, which is a difference that also could have affected persistence. The fact that two of the stayers were already thinking about the benefits of paid research when they applied to the WSTEM program evidences their commitment to and understanding of what was required in a STEM career.

The life histories in this study indicate that the WSTEM program had a number of positive effects on both stayers and leavers – particularly in the supportive community they found there. (See Appendix A for a table of all participants and their STEM persistence measures.) Eleven WSTEM participants said that they found the support network formed within WSTEM to be beneficial. Five participants discussed the motivation and knowledge that meeting members of the professional community provided. Four women reported on the positive effects of the paid research opportunities provided to members. And three women mentioned the positive effect of the women-only aspect of the program. Despite these positive influences, six of these women did not persist in their STEM majors. The following sections provide evidence for the different influences and results in terms of persistence.

Support network. This study like others demonstrated the importance of peer support (e.g. Robnett, 2013). Eleven of the twelve WSTEM participants mentioned the positive influence of the formal peer support network formed in WSTEM. The positive influences cited fell into the following categories: provided help with studying; gave participants confidence in classes because they had other women that they knew surrounding them; provided a source of motivation in knowing that others were going through the same thing; and served as a general source for friendships. The first three are STEM-specific and were identified more by stayers when compared to the general social goal, which was identified more by leavers.

Nine women mentioned the positive influence that WSTEM had on their performance in their STEM classes based on the help and support they received within the program, particularly from their peers. For example, Sarah – a WSTEM Stayer – described how all the women on her floor were at “different levels” in their STEM classes. She mentioned a friend who had already taken calculus in high school who could help her with her current calculus class. Sarah also noted that a number of women on the floor were taking the same classes, which allowed them to easily form study groups. This sentiment was also expressed by leavers, including Nella, a WSTEM Leaver, who discussed how her roommates and she "were all taking [bio] together and [could therefore] study together."

This support group in the dorm also translated into confidence in classes because WSTEM members knew others from the program in their classes and did not have the feeling of isolation – a goal mentioned by the program director. Andrea – a WSTEM Stayer – described this feeling as follows: "It's nice to have someone next to you that you know. It gives you more confidence for the class." In a similar way, other WSTEM participants discussed this sense of comfort and overcoming a sense of isolation by describing the concept of knowing others on their floor were "going through the same thing" (Andrea). The peer support network also served as a source of motivation to persist. Another WSTEM Stayer, Jill, explained, "It kept me going, knowing that there were others like me that wanted to reach their goals, just knowing this group of girls was going through the same thing I was career-wise and class-wise." This sense of camaraderie and confidence allowed the stayers and in some cases the leavers to see that others were encountering struggles but were able to persist. Consequently, they could use this support network to rationalize their identification with STEM, to maintain an expectation of success in spite of the struggles, and to see value in this success (Carlone & Johnson, 2007; Eccles, 2007).

Many of the leavers' motivations for joining WSTEM were not specifically tied to STEM interest. Eight of the WSTEM participants – including the six leavers – cited general social support as a benefit of the program. These women mentioned how successful the program was in helping them to develop friendships with other women that provided support through their early college experience. Mary, a WSTEM Stayer, described the formation of friendship as follows:

> It was amazing living on the floor. Most of your friends were right there with you and we knew each other and we could walk to class together or walk back home together and that was fun. Because your first year, you're like, "I'm never gonna make any friends, no one is gonna know me."

Patty, a WSTEM Leaver, explained, "The biggest benefit of WSTEM was the relationships I had with those girls." These comments suggest that WSTEM served as a source of social support although this did not always translate into persistence in the STEM major.

Despite most (five of six) of the WSTEM leavers mentioning the positive support they received in the program, only two of these women felt that they had received support within their major. Five leavers discussed how WSTEM helped them to make friends and develop relationships with women with whom they still keep in touch, but noted the program did not provide support that they felt carried over into their STEM major. This indicates that social support found within WSTEM was not enough to maintain persistence, especially if the participants did not sense that they were supported in their STEM major.

Meeting members of the professional community. Another benefit mentioned by five of the participants (four WSTEM stayers and one leaver) was meeting female guest speakers and researchers, which served as a source of inspiration and motivation. Some of these participants commented on the inspiration they felt seeing successful women in STEM fields. For example, Jenn (a WSTEM Stayer) mentioned how "nice it was to see successful women in different STEM fields." Similarly, Mary (a WSTEM Stayer) credited these women and the other opportunities provided by the WSTEM Program Director (Dr. Smith) as motivating her to work harder to be successful as a woman (and subsequently a minority) in STEM: "Dr. Smith gives all of us resources to make us better, to strive for what we really want and try to be equal to men." Here Dr. Smith served as an example of the professional community and motivated Mary to work toward that same level of STEM identity.

The guest speakers helped to provide motivation which was different in nature from the motivation gained from living on the floor with like-minded students. The guest speakers served as role models, allowing the women in WSTEM to ask questions about STEM fields, including how these women balanced family and career. The one-on-one interactions and the speakers motivated many of the WSTEM participants to persist. These women were able to determine whether they could identify with the women they met and whether the professions they discussed fit with their current and future goals and interests (Eccles, 2007).

Research opportunities. Four of the WSTEM participants (three stayers and one leaver) mentioned the benefit of the paid research opportunities provided by the program. These research opportunities gave participants the opportunity to demonstrate their skills in front of respected others (faculty) which can improve their STEM identity trajectory (Carlone & Johnson, 2007). Jill (a WSTEM Stayer) felt that the research opportunity she participated in would "help her along the way" to her eventual career. Mary and Andrea (both WSTEM Stayers) felt that being paid by WSTEM opened the door for more research opportunities because the professors and departments did not have to worry about paying them. Andrea described the confidence that she developed from her research opportunities as follows:

> Every opportunity offered to me has been through WSTEM. If I hadn't had these research opportunities, I don't know where I would be. When you're in WSTEM research, they pay you, they expect you to do a really good job, you know you have a higher expectation when you get paid, you must get something really good, because you're getting paid for it. So you carry on your own project. You're not a clerk, you're not someone who cleans up after the graduate students; you're someone who carries on her own project.

These women not only gained experience in research but also felt empowered because they were able to pursue their own interests. By participating in research opportunities, the women were able to be recognized by respected experts and see what their future career would be like, which allowed them to decide whether their career interests matched their goals and identity (Carlone & Johnson, 2007; Eccles, 2007). Beatrice was the only WSTEM leaver who took part in a research opportunity. She actually stayed in her engineering major for three years and credited the research as one of the reasons she persisted so long. Eventually she began to doubt her competence because of the grades she received, despite studying for long hours and asking her professors for help. Beatrice also began to doubt her identification with her peers in engineering:

> Engineering has nothing to do with me. I'm just wide open and engineering is just the complete opposite of me. The engineering students are the nerds of the nerds, and I don't fit in with them.

Beatrice articulated the issues that other leavers experienced. Despite participating in research opportunities, having positive experiences there, and meeting female role models who supported her STEM career, she was unable to see eventual success in engineering due to her grades and her inability to see herself fitting in with her peers (Carlone & Johnson, 2007; Eccles, 2007).

Women-only. The final positive influence of WSTEM that was mentioned by participants was the women-only aspect. Three of the WSTEM participants (two stayers and one leaver) mentioned the positive aspect of living with and attending some classes and social outings with all women. These participants explained they felt less pressure to fit in under these circumstances. Sarah (a WSTEM Stayer) expressed this sentiment best:

> It's not bad to have classes with guys. It was nice to have just the girls in a class. It just seems like there was more, you were able to relate to people more, you weren't paying attention to "oh there's a cute guy sitting in the corner" or you know "oh what are they wearing," that sort of thing; it was more camaraderie I suppose.

The three stayers who mentioned this aspect also became committed to helping to increase the number of women in STEM fields. Jenn often returned to her middle and high school to talk about her physics major and to recruit students, especially female students, into physics. All three women believed that they would not have had this experience without the women-only structure of WSTEM.

The Negative Aspects of WSTEM

Despite the many positives reported by the WSTEM participants, three women mentioned negatives to the program. All three of these WSTEM leavers complained about the WSTEM policy that forced students who switched to a non-STEM major to leave the dormitory within a semester. These women indicated that this rule made them feel like their new major was inferior to the STEM majors. They felt that this forced departure from the program made them feel like failures. This sense of disappointment suggests that these women had positive attitudes toward the social network they formed within WSTEM because they were upset about having to leave it.

Themes that Highlight Differences between Stayers and Leavers

Motivation for Joining WSTEM. More leavers appreciated the social aspects of WSTEM rather than the academic aspects and were motivated to join WSTEM for these general social aspects as opposed to STEM interest. There are two key issues to point out here: first, the leavers' lack of STEM-specific motivations for joining WSTEM could be an indication of a lower intrinsic interest in STEM; and secondly, if leavers were not taking advantage of as many academic aspects as stayers, this could be part of the reason for their lack of persistence. Because of the structure of this study – a reflective life history interview – it is impossible to determine whether these young women were less committed to STEM than their staying peers when they entered SU. Also, it is impossible to say if participation in more opportunities would have improved persistence. What this result can demonstrate is that five of the six leavers saw positive benefits in their formal support network within WSTEM; however, they were not able to maintain their STEM identity, see themselves succeeding in STEM, or value the STEM career as worth the cost once they encountered issues within their STEM departments (Carlone & Johnson, 2007; Eccles, 2007).

Gender Perspective. Another difference between the leavers and stayers was that all of the leavers believed there were definite differences between men and women that affected their choices. Three of these leavers said women are "more emotional" and "more caring" than men, which affected their career choices. And all of these leavers believed that women were treated poorly in STEM careers, despite having never experienced gender discrimination personally. This perception of the gender discrimination that existed in STEM careers influenced their decisions to choose more female-friendly careers in which women are better represented. Because of their interest in helping people, Nella (a WSTEM Leaver) chose to become a child psychologist and Patty (a WSTEM Leaver) chose to become a social worker. Lorraine chose to become a marketing representative for a fashion company.

Summary. The common theme among all the benefits described by the WSTEM participants was the concept of confidence and empowerment that WSTEM developed in these women. The structure of WSTEM helped alleviate the isolation that many of these women could have experienced based on their minority status in their STEM majors or simply because of the large class sizes at SU. Being surrounded by other women interested in similar fields helped them feel that they fitted in with their peers. Finally, the interactions with professionals in the field helped them determine whether their career choice fitted with their goals. The leavers' decisions were affected more by the experiences they had in their majors than by their experiences in WSTEM.

Leavers tended to be motivated to join WSTEM for non-STEM related reasons, and these women believed in gender stereotypes that could negatively affect their ability to identify with STEM and see themselves fitting in with STEM fields (Carlone & Johnson, 2007). Although the leavers were able to gain some benefit from WSTEM in terms of friendships, a positive research opportunity, tutoring, and the female guest speakers, these benefits were not enough to maintain persistence as each of these leavers began to doubt their ability to succeed in their STEM career and/or were no longer able to fully identify with their perception of STEM professionals (Carlone & Johnson; Eccles, 2007). WSTEM could not change some women's perceptions that faculty and peers were unhelpful and unsupportive, nor could it change the frustration that many of the leavers felt regarding their poor grades. WSTEM also could not force members to participate in all activities, which was evident from the fact that four of the leavers did not fully participate in all the opportunities, including the research opportunities. Based on these data, one can conclude that WSTEM did meet its goals for the women who fully participated in it. Of those women who participated in research opportunities, all but one of them persisted. And all but one of the women said the social aspect of WSTEM was a positive influence on their overall college experience if not their STEM college experience.

Characteristics of Women who Chose Not to Join WSTEM

The second research question for this study asked: how do the internal and external influences that affected each woman's life history compare for WSTEM participants and the non-WSTEM participants. In this study, the WSTEM participants chose to join this program. These women were specifically looking for a formalized support network. Previous research has indicated that the benefits of programs like WSTEM are often confounded by the self-selection of the type of person who chooses to join it (Brainard & Carlin, 1998). To address this issue, I asked the participants from the general SU student population what they thought about programs like WSTEM – women-only programs that provide support and opportunities to improve women's persistence in STEM fields. Their responses indicated that non-WSTEM stayers had a different view of these programs than non-WSTEM leavers, which has implications for programs like WSTEM and their goals of increasing the number of women in STEM.

The non-WSTEM stayers believed that programs aimed at improving persistence in STEM fields should be based on merit, not gender. All of the non-WSTEM stayers in this study were aware of WSTEM but reported choosing not to join it because they wanted to persist "on their own." Ironically, all of the non-WSTEM stayers indicated that they found a support group among their peers and a supportive mentor who positively affected their persistence. Therefore, these women became part of informal support networks that were crucial to their persistence. These stayers explained that they did not want a formalized, artificial support group; they would rather form a group of like-minded individuals within their major – a description that was also mentioned by WSTEM participants of the program. Perhaps the attitude of "I want to do it on my own" motivated these non-WSTEM stayers to succeed. Like the WSTEM stayers, the non-WSTEM stayers also saw gender as simply sex differences not differences that dictate what career individuals will be successful in (Hughes, 2012).

In comparison, three of the non-WSTEM leavers believed in hindsight that participation in a program like WSTEM could have positively affected their persistence. All six non-WSTEM leavers said that when they first came to SU, they too wanted to persist in STEM without the help of a formalized support group. And yet all six chose to leave. As a previous article demonstrates, this result was due to their inability to find a support group and the stereotypical views of gender that they held (Hughes, 2011). All of the non-WSTEM leavers believed that there were definite differences between men and women in their reactions to phenomena and their personalities (similar to the WSTEM leavers). This view that women possess traits that might not be prized in STEM fields could have affected their motivation to continue.

This data highlights the important role that support networks (whether formal or informal) have on women's persistence in STEM majors (Robnett, 2013). Based on the interviews with the non-WSTEM stayers, co-gendered support networks were just as beneficial as WSTEM to STEM persistence for those participants who found them (Hughes, 2012). The data also highlights how the culture of STEM departments – despite open access to women – continues to prevent women who believe in more traditional female roles from persisting in STEM and finding support networks in STEM.

LIMITATIONS

There are two limitations to this study. First, I have only these young women's reflections on their experiences. These reflections are an important piece of the narrative life history and fit within my framework – in that these women could reflect on the changes in their expectation of success, the value of that success and how their STEM identity evolved over their university experience (Carlone & Johnson, 2007; Eccles, 2007). However, because the study utilized their reflections, it is difficult to identify the exact external experiences that occurred and how these young women internalized these. An ethnographic study that follows women across their university experiences to identify exactly when they begin to question their persistence and how this is negotiated over time would be an interesting follow-up. Despite this, the results of this study are still important to researchers and policy makers in that they demonstrate that motivation for STEM career choice and gender stereotypes are important factors that affect persistence, particularly as the current culture of STEM exists.

The second limitation to this study is that I did not interview male students. Future studies should compare male stayers and leavers to determine if their reasons for leaving/persisting are similar to women's. Further, the influence of support networks on men should be explored and compared to women.

CONCLUSION

The results of this study indicate that perceptions of gender still play a role in STEM decisions even if it focuses on a small, but in-depth, group of participants. Gender discrimination was a driving force behind WSTEM's formation as described by the program directors. The directors created WSTEM as a way to alleviate gender discrimination by providing women with access to other like-minded individuals and to opportunities within STEM fields. And yet, the supportive community created in WSTEM did not carry over to all departments. Slightly less than half of the WSTEM 2006 cohort chose to leave STEM because of the inability to identify with their chosen STEM major and because they could not find supportive networks within their majors. This percentage of leavers is not indicative of a failure of WSTEM. Many of the leavers chose careers/majors that better matched their goals and identity particularly in comparison to their experiences in and perceptions of the culture of STEM careers (Hughes, 2011, Eccles, 2007). Often the support network of WSTEM was not present in their original STEM major, leading them to sense that they did not belong or could not succeed in these majors.

Eccles' expectancy value model was a useful framework (2007). Intrinsic value was influential in these participants' persistence in STEM. Those participants who joined WSTEM for extrinsic reasons, such as living in a nicer dormitory, eventually left their STEM major, indicating that the type of motivation affected persistence. Those women who were motivated to join WSTEM based on personal interest in STEM fields and a desire to live with like-minded individuals persisted.

In response to how WSTEM affects women's decisions to persist in STEM fields, this study suggests that providing access to a female-friendly support group provided benefits to the participants' overall persistence. However, the female-friendly environment within WSTEM did not always translate into female-friendly policies within STEM departments. Programs like WSTEM are one part of a much larger combination of cultures including: individual STEM departments, the university, and the overall cultural and social norms. The gender stereotypes at all levels need to be addressed before women can fully identify with various STEM fields (Harding, 1997; Lemke, 2001). If women cannot identify with STEM careers, then they will continue to be underrepresented in these fields, particularly at higher levels such as faculty (Carlone & Johnson, 2007).

Despite the issues involving the culture of STEM departments there are important findings from this study on WSTEM in regard to what living and learning programs – and STEM departments – can do to improve persistence. As this study, and a previous study conducted by the author (Hughes, 2012), demonstrate, peer support networks have positive effects on women's persistence in STEM. The issue with LLCs is that the network often disintegrates after the first year as indicated by comments from my own participants and other studies (Kahveci et al., 2007). This is a problem since many students encounter increasingly difficult courses as they move through university. Consequently, if these programs can be extended into a second year of dormitory living this might enforce the support group that the women cited as being a positive motivation for them to persist. Secondly, LLCs – like WSTEM – combine multiple STEM majors on one floor. This can be difficult in that the culture within some majors may be more female-friendly than others. LLCs should work with departments to create informal and formal groups within departments so that students can meet peers who are experiencing the same classes and perhaps the same difficulties that they are experiencing. Thirdly, since the chilly climate was mentioned by all but two of the participants in my study, perhaps it is necessary to incorporate a one-credit course for all STEM majors at SU – and perhaps at other universities – taught through the Women's Studies department that focuses on the gender issues and stereotypes that have historically influenced the underrepresentation of women in STEM. Researchers argue that the culture of STEM and the status of underrepresented groups within it cannot be changed until members are confronted with the stereotypes and dominant discourse that exists (e.g., Calabrese Barton, 1997). Finally, programs like WSTEM should conduct annual evaluations to determine what aspects of the program are improving persistence over time.

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ENDNOTES

1 – For the purposes of this study, STEM career choices or majors will refer to those majors offered by the university in this study. These majors include biochemistry, biological sciences, chemistry, computer science, engineering, geology, mathematics/statistics, meteorology, oceanography, physics, and scientific computing.

2 – Title IX was created in response to a series of policy demands occurring during the 1960s (Anderson, 1995). Initially this policy was enforced at the athletic level (Carpenter & Acosta, 2005). Title IX can only be enforced on programs and schools that receive federal funding. In order for these organizations to be deemed in compliance and to continue to receive federal funds, they must adhere to one of three options: The number of available opportunities for each gender must be proportional to the number of each gender's interest and numbers, the program or institution must show a history of program expansion in response to the interests and abilities of each gender, and the program or institution must show that its present programs "fully and effectively" (Carpenter & Acosta, 2005, p. 77) address the interests and abilities of each gender.

3 – I have chosen to refer to programs using the term sex rather than gender because the basis for entry is based on sex – the biological trait of being male or female – not the more complex concept of gender (Glasser & Smith, 2008).

4 – The participants' original declared majors in this study ranged from physical to life sciences: 58% biology (n=15); 15% chemistry (n=4); 15% engineering (n=4); 8% physics (n=2); and 4% exercise science (n=1).

5 – In order for American organizations to be deemed in compliance with title IX and to continue to receive federal funds, they must adhere to one of three options: The number of available opportunities for each gender must be proportional to the number of each gender's interest and numbers, the program or institution must show a history of program expansion in response to the interests and abilities of each gender, and the program or institution must show that its present programs "fully and effectively" (Carpenter & Acosta, 2005, p. 77) address the interests and abilities of each gender.

6 - Rationale for Stayer and Leaver Classification: The NSF (2007) defines STEM majors as those that fall into the following categories: mathematics, natural sciences, engineering, computer/information sciences, and social/behavioral sciences. However, recent federal reports and policy initiatives that focus on increasing persistence in STEM mainly focus on mathematics, natural sciences, engineering, and computer/information sciences (AAUW, 2010). I used this latter categorization for STEM majors in this study because it was also the agreed-upon categorization of the WSTEM director with whom I spoke. As a result, individuals who were majoring in any of the following official majors at State University were considered STEM majors: biochemistry, biology, chemistry, computer/information science, engineering, geology, mathematics, meteorology, and physics. I also categorized stayers and leavers according to their chosen career afterward. [new insertion: deleted appendix and put end note here for word count]

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APPENDIX A: Information on Participants

Particip ant	Original Major	Final Major	Career Goal	Ave HS Math and Science Grades *	Ave College Math and Science Grades *
WSTEM Stayers[6]					
Jenn	Biology	Environmental chemistry	EPA/Fish and Wildlife/SeaWorld/Zoo	A/B	B
Andrea	Biology	Biochemistry/ Biomathematics	PhD in physiology or molecular med	A	A
Sarah	Physics	Physics	PhD/Physics		
Mary	Biology	Biology/Psychology	Pediatric Endocrinologist	A/B	A/B
Claire	Chemical Engineer	Environmental Engineering	Grad school engineering	A	B
Jill	Biology	Biology	Pediatric Dentist	A	B
Non-WSTEM Stayers[6]					
Wanda	Biology	Chemical-Biomedical Engineering	PhD/specializing in robotics	A/B	A/B
Barbara	Physics	Physics	PhD/Physics	A/B	A/B
Robin	Biology	Chemistry	PhD chemistry	A/B	B/C
Laura	Chemistry	Chemistry	Physician's assistant/later in life chemistry teacher	A	B
Beth	Marine Biology	Geology	Master's in research	A	B
Anna	Biology	Environmental Studies	Wildlife biologist	A	A
Caroline	Biology	Biology	Veterinarian	A	A
Julie	Engineering	Environmental Engineering	Grad school engineering	A	B/C
WSTEM Leavers[6]					
Beatrice	Chemical Engineering	Chemistry Education	HS Chemistry teacher	B	B
Nella	Chemistry	Psychology	Child Psychologist	A	A/B/C
Patty	Biology	Sociology	Social Worker/Counselor	A	A
Lorraine	Biology	Marketing Psychology	Marketing representative for fashion industry	A	A/B/C
Francine	Exercise Science	Social Science Education	Teacher	A	A/B/C
Renee	Biology	Environmental Studies	Lawyer/Lobbyist	A	C
Non-WSTEM Leavers[6]					
Seely	Biology	Creative Writing/Communications	Editor/Writer	A	A/B/C
Tara	Biology	Humanities	Run an exotic animal shelter	A/B	A-F

Lily	Civil engineering	Classical civilizations	Master's/PhD in history	A	A
Megan	Chemistry	Nursing	Nurse	A	A/B
Malin	Biochemistry	Sociology	PhD sociology	A	B/C
Kathryn	Biology	English literature	Book editor/advertising	A/B	B/C

*These were self-reported grades. This is their average course grades in STEM related classes.