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Considering the Role of Gender in Developing a Science Identity: Undergraduate Students in STEM Fields at Large, Public, Research Universities

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ABSTRACT

This study investigated the extent to which male and female students in STEM fields at large, public, research universities develop a science identity. The study draws upon online survey results of 1,881 undergraduate students. The survey included measures that assessed a student's sense of identity as a scientist and perceived self-efficacy. Recognizing that male and female students may report identifying as a scientist and self-efficacy levels differently by major, comparisons are made between respondents who majored in the following STEM fields: 1) Physical Science, Computer Science, Math and Engineering (PSCSME); 2) Agricultural and Biological Sciences (ABS); and 3) Health Sciences and Psychology (HSP). Results revealed that gender differences exist between male and females in science identity as well as perceived self-efficacy. Science identity is impacted by students using and doing science, rather than by self-efficacy. Findings from the study may be used to inform programs and practices that aim to strengthen students' science identity. With this in mind, practices such as positive feedback along with effective teaching styles, and grading could be influential approaches to creating an environment where students have the ability to establish a skill set and knowledge within science related fields and can contribute to helping students develop a science identity.

INTRODUCTION

In recent decades, the impact of identity development on educational outcomes has received considerable attention (Pascarella and Terenzini, 2005). Although higher education researchers are at odds when explaining the college student development process, "most writers view development as a general move toward greater differentiation, integration, and complexity in the ways that individuals think and behave" (Pascarella and Terenzini, 2005, p. 19). Development in college is important because not only is it a time where identity is thought to be driven by college experiences, but it could impact students' post-college plans, including graduate school and choice in professional careers. Numerous theoretical and conceptual models attempt to explain student development in a college setting. Interestingly, scholars have been unable to develop a comprehensive model to explain student development.

While many studies have been conducted on college student identity development, less has been done on student identity development in relation to self-efficacy within their major field. Hamrick, Evans, and Schuh (2002) assert that, "The college experience is widely regarded as offering many opportunities for students to develop, among other things, personal and professional identity" (p. 135). In addition, the process of identity development among traditionally aged students is significant during college because the late adolescent years (e.g., 18 to 22) are regarded "as a crucial time for identity formation" (Muuss, 1996, p. 62). During college, students have the opportunity to explore majors, careers, as well as develop a sense of self, academic and personal relationships, and a professional identity. For these reasons, college is a critical time in which to examine students throughout their transitioning stages.

In Science Technology, Engineering, and Mathematics (STEM) fields in particular, where much of a student success is based on math and science knowledge, identify formation can

also impact student success. This paper is specifically interested in the development of college students' self efficacy in relation to their identity as scientist or science identity. Understanding the characteristics of identity development in college, and specifically in STEM majors, will enable researchers, scholars, and program directors better assist students develop their identities and succeed in STEM majors.

Project STEP-UP

The study presented here is part of a larger study on underrepresented undergraduates in the STEM fields at large, public, research universities, called Project STEP-UP (STEM Trends in Enrollment and Persistence for Underrepresented Populations).[1] Project STEP-UP focuses on the individual and institutional factors that impact the educational outcomes of undergraduate women, students of color, and low-income students in STEM majors. Using qualitative and quantitative data, Project STEP-UP investigates trends such as students' entrance into, persistence in, or movement out of STEM fields; how intervention programs that seek to increase recruitment and retention of students in STEM are designed and implemented; and differences in students' participation by type of STEM field. One component of the project surveys undergraduate students in STEM fields across nine universities, to investigate reasons for and influences on students' choice of major, as well as assesses students' experiences in their major.

The objective of the study presented here is to investigate the extent to which students in STEM fields at large, public, research universities identify as a scientist and investigate their levels of self-efficacy. In particular, this paper seeks to understand how undergraduate STEM majors identify as scientists, as well as their level of confidence in math and science. Other self-efficacy measures are included, to help investigate the extent to which students feel they can

[1] Additional information about Project STEP-UP can be found on our website at: http://stepup.education.illinois.edu/

achieve their goals, and assessing whether their accomplishments are based on planning and hard work or good luck and fortune.

The decision to focus on undergraduate students attending large, public, research universities is due to the vast number of students these types of campus serve, the number of STEM degrees awarded to students per year, and campus-level commitments to the STEM fields through teaching, research, and scientific innovation. In 2008-2009, over 7.2 million undergraduate students were enrolled in public four-year colleges and universities across the country, representing approximately 30 percent of the total undergraduate population (Integrated Postsecondary Education Data System, 2009). In addition, these types of higher education institutions collectively confer over two-thirds of both bachelor's degrees awarded in STEM, making them ideal settings in which to examine undergraduate students' experiences in the sciences, including self-efficacy and science identity.

LITERATURE REVIEW

College Student Development

In 1991 Pascarella and Terenzini reviewed work written since 1967, that examined the "impact of higher education on student development" (Chickering and Ressier, 1993, pg 1). Through this examination of major founders and contributors of student development, we now have suggested categories that encompasses major theoretical models that helps us study identity development. As a result of this review of major college development theoretical frameworks, authors such as (Knefelkamp, Widick, and Parker 1978; Moore, 1990; Rodgers, 1990; Strange and King, 1990), suggest that the process of developing an identity can be examined from four major theoretical lenses. Those lenses include a cognitive theoretical perspective, psychosocial

theoretical perspective, typology perspective, and person-environment interaction perspective (Chickering and Ressier, 1993, pg 3). In addition recent studies by (Tinto 1975 and Weidman, 1989; and Kaufman and Feldman, 2004), have examined identity development in college from a sociological perspective.

Despite the diverse fields of study to examine identity, each theoretical framing constitutes a different way of viewing how students develop. This paper will study will draw upon psychosocial theoretical perspectives because "identity development is a prominent issue in most psychosocial theories of change among college students" (Pascarella and Terenzini, 1991, pg 20). Psychosocial theories "view development as a series of tasks or stages, including qualitative changes in thinking, feeling, behaving, valuing, and relating to others and to oneself" (Chickering and Ressier, 1993, pg 2). In previous studies, traditional psychosocial theoretical frameworks have examined identity development as it relates to gender identity, racial/ethnic identity, and gay, lesbian, and bisexual identity. It wasn't until recent decades that studies have sought to examine different characteristics to understand how students come to develop a sense of identity within their major, careers and professional field. This development has allowed for the exploration of identity development in STEM related majors, careers, and professional fields. Considering there has been a national movement to prepare students for STEM related majors and careers, it is essential to examine the process in which students identify themselves in STEM related fields.

Understanding that STEM fields are heavily based on student success in core courses and exams, utilizing components of the psychosocial, and self efficacy framework to examine how students feel about themselves and their capabilities will allow us to better assist students in their endeavors to succeed in STEM related fields.

Science Identity

For students majoring in STEM, the process of developing an identity can be complicated, particularly for students who are underrepresented in these fields. A study conducted by Seymour and Hewitt (1997), which examined science majors in different U.S. college and universities, found "features of science departments that aligned with masculine norms and values, particularly the competitive nature of weed-out courses and unfriendly professors."

Norms already associated with STEM may deter underrepresented students from establishing a science identity. Carlone and Johnson (2007) note that, "Undergraduate science majors often must negotiate a culture characterized by white, masculine values and behavioral norms, hidden within an ideology of meritocracy" (pg. 1187). Underrepresented minorities science development may be hindered by the cultural and gendered norms inherent in STEM fields, particularly in fields like Engineering and Computer Science. Thus, understanding characteristics of how students majoring in STEM fields, come to their own development of a science identity becomes critical when examining their success in STEM. To date there has not been a consensus on the definition of the coined term science identity, or what it means to be a scientist. Rather studies have focused on various components of college experiences, skills and knowledge that they felt when combined contributed to a students development of a science identity.

A study conducted by Hunter, Laursen, and Seymour (2006) examined the role of undergraduate research on student's cognitive, personal, and professional development in relation to them becoming a scientist. To understand this development, characteristics of becoming a scientist included, "demonstrating attitudes and behaviors needed to practice science,

understanding the nature of research work, understanding how scientists practice their profession; and beginning to see themselves as scientists" (pg 49). These characteristics were examined from both student and faculty observations. From a faculty perspective, they found that Becoming a scientist dealt with transitioning into becoming a science professional by not being afraid to be wrong, and exhibiting behaviors that underpins research work. For students becoming a scientist dealt with "changes in their attitudes and behaviors in relation to research work" (Hunter et al, 2006, pg 55).

Overall the findings from faculty and student statements focused on the growth "in understanding both salient areas of science and how to apply knowledge to the professional practice of science"(pg 71), development in confidence as well as competence, personal growth in attitudes as well as behaviors, roles of a researcher, and identifying with a project (Hunter et al, 2006).

Carlone and Johnson (2007) also examined student science identity. They examined science experiences of 15 successful women of color utilizing science identity as an analytic lens. To understand the science experience through undergraduate and graduate studies that eventually led to science-related careers, they developed a science identity model. The components of their model included "competence, performance, and recognition" (pg 1190). In this study competence referred to "the knowledge and understanding of science content. Performance was viewed as the way of "talking and utilizing tools", and recognition was broke down into three categories: 1.) Research Scientist Identities, which incorporated recognition of oneself as a scientist and recognition by others as a scientist 2.) Altruistic Scientist Identity, which included how the women defined themselves, and 3.) Disrupted Science Identities that looked at their perceived behaviors and or appearance that triggered "racial, ethnic or gender

recognitions that overwhelmed their chances of being recognized as good science students" (pg 1202).

In viewing all components, they found that there were no strong patterns in competence across the groups of women. For the most part, the women had a 3.10 or higher. In the instance of performance, Carlone and Johnson (2007) were not able to draw conclusions due to the nature of the study. The study did have an observational component and relied interview responses, thus drawing conclusions on performance was not tangible. Recognition in this study is the most noteworthy. They found that the recognition component was an important part of science identity formation for the women of color.

College student development frameworks and the following studies desribed, set the beginning stages to study the extent to which students in STEM fields develop a science identity. The frameworks provide an analytical lens, while the studies provide the beginning stages of variables to consider in science identity models. One aspect of the science identity that is prevalent across the theoretical framework and studies is the notion of recognition of relating to oneself and relating to others.

Recognition by others is a consistent variable that deserves much attention when considering different components as to how student come to develop a science identity. This study also utilizes recognition in science identity development by viewing it as how you see yourself, how others see you, and how doing science is part of who they are. Besides viewing how students internalize recognition, we are also interested in how self-efficacy interacts with science identity. Further we seek to know if there are differences by gender.

Self-Efficacy

Much discussion of self-efficacy begins with Bandura's (1977) work Self-Efficacy: Toward a Unifying Theory of Behavioral Change. From this onset self-efficacy has been examined in various fields. Bandura (1994) assert, "A strong sense of efficacy enhances human accomplishment and personal well-being in many ways" (pg 1). In addition, Pajares (1996) suggest that research on self-efficacy "has focused primarily in two areas" (pg 551). The one area that will be the primary focus in viewing self-efficacy, involves "the link between efficacy beliefs and college major and career choices, particularly in the areas of science and mathematics" (Pajares, 1996, pg 551). Many studies report that self-efficacy can predict outcomes and expectations in core science courses, capabilities within science related fields, and career goals. A study conducted by Lent, Brown, and Larkin (1986) examined self-efficacy and predication of academic performance and career options for students considering science and engineering fields. Self-efficacy and the strength of student's self-efficacy were measured.

To measure self-efficacy, respondents were asked to "indicate whether they believed they could successfully complete educational requirements and job duties performed in 15 science and engineering fields" (pg 551). The strength of self-efficacy was measured by asking students to "estimate their degree of confidence in their ability to complete these educational requirements and job duties" (pg 551). To highlight significant findings, when groups were divided into high and low self-efficacy groups and compared to two specific academic outcomes, grade point average in science/technical work, as well as number of quarters completed as a student in technology, significant mean differences were found.

"Differences consistently favored high-self-efficacy subjects, who achieved higher grades and remained enrolled longer in the college of technology than did the low-self-efficacy groups" (pg 266). More significant findings where found that support other researchers studies that assert self-efficacy expectations are related to indices of academic performance behavior (Hackett & Betz, 1984b; Lent et al., 1984).

Another study conducted by Lent, Lopez, and Bieschke (1991) examined mathematic self-efficacy: sources and relation to science-based career choices of undergraduate students. Self-efficacy was measured by utilizing multiple scales (Bandura 1986; Betz and Hacketts 1983 and Betz 1978). Respondents where asked questions such as to what extent they were confident in to complete mathematic related courses. Findings from this study reveal, "men evidenced higher mathematics self- efficacy and Mathematics ACT scores than did women" (Lent et al, 1991, pg 428). Further, when the authors regressed self-efficacy with other variables, gender no longer played an important role. Lent et. al assert that this difference can be explained by past performances and difference in efficacy building in this field.

From this onset you can infer that having a strong sense of self-efficacy in basic skills required in STEM related fields is important to student major and career success in STEM. Thus for students in STEM, the ability to have confidence in your capabilities to perform in STEM is essential. In essence the way a student feels about his or herself plays a role on self-efficacy as well. Thus looking at how students feel about themselves along with how they feel about their capabilities is important to understanding persistence in STEM related majors and careers. Student self-efficacy will serve as an additional lens of analysis to understand the extent to which students come to develop a science identity. Self-efficacy is defined as "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events

that affect their lives" (Bandura, 1997, p. 171). Baber, Pifer, Colbeck, and Furman (2010) suggest that having a strong sense of self-efficacy results in people having the capacity to deal with challenges they encounter. Alternatively, having a weak sense of self-efficacy "may cause an individual to underestimate his or her skills and abilities, resulting in perceptions of difficult tasks as challenges to be avoided" (Baber et al., 2010, p. 31). This paper focuses on students' self-reported, perceived self-efficacy, rather than observed self-efficacy (Baber et al. 2010).

DATA AND METHODOLOGY

This study uses data from an online survey of current undergraduate students at nine large, public, research universities. The survey asks questions about students' experiences in the STEM fields, including pre-undergraduate and undergraduate factors that impacted their decision to enter the STEM fields. In addition, special attention is given to the process by which the student initially declared their major, their decision to remain in or leave their major, and any involvement in STEM intervention programs that may have influenced their choice of major. The survey was administered in Summer and Fall 2010. The researchers contacted individuals at each campus who had contact with students in a variety of science- and math-based majors, including academic advisors, directors and administrators of STEM interventions programs, and leaders of STEM student organizations (e.g., Society of Women Engineers). If the individual contacted agreed to distribute the survey, an electronic invitation to participate which included a link to the survey was forwarded to the contact, who then forwarded it to their student contacts. Student participation was confidential, and the liaison that the invitation was sent through was not notified of which students began and/or completed the survey. Students who completed the

survey and provided a university email address received an incentive, in the form of a $10 Amazon gift card.

This paper will focus on students' experiences in a variety of STEM majors, specifically their sense of identity as scientists and measures of perceived self-efficacy. A Likert Scale with responses ranging from "strongly disagree" to "strongly agree" was used for each variable.[2] The set of 17 questions pertaining to self-efficacy have been used in other surveys, such as the Gates Millennium Scholars survey (see Appendix A). For this study, Cronbach's Alpha for the self-efficacy questions was 0.924, indicating that the construct has a high rate of internal reliability.

The survey questions pertaining to Science Identity, specifically the recognition component, were informed by a study on science identity conducted by Carlone and Johnson (2007). The questions influenced by Carlone and Johnson (2007) were combined with new questions created by Project STEP-UP research team. The 14 questions pertaining to science identity had an overall Cronbach's Alpha of 0.937, also indicating a high level of internal reliability. However, as the specific construct for science identity that was used in this study had not previously been used and the overall reliability of using this particular set of questions is unknown, Principal Axis Factor (PAF) Analysis was performed to reduce the data and see if there were specific constructs within the larger set of 14 questions. PAF was chosen as the appropriate method for its ability to examine shared variance across multiple variables, and to determine the constructs found at the core of the set of questions.

PAF resulted in two distinct factors that utilize 12 of the 14 variables, which collectively explain 66 percent of the variance within the overall set of science identity questions: 1) *Identifying as a Scientist*; and 2) *Using and Doing Science*. The respective Cronbach's Alpha was 0.940 and 0.831. The specific survey items for each factor are provided in Appendix A. A

[2] Negatively-scaled items were rescaled prior to analysis.

composite score for the first factor, Identifying as a Scientist, based on the means of the responses across the 8 variables included in the construct. This composite variable served as the dependent variable in regression analysis which investigated the relationship between students' science identity and their self-efficacy. In addition, basic descriptive statistics and cross-tabulations were performed on each of the science identity and self-efficacy measures included in the survey, with chi-square tests used to determine what differences, if any, were statistically significant.

The following research questions about undergraduate students in STEM fields were used to guide this study and the analysis performed:

1. Do science identities differ by gender? If so, how do they differ?
2. How do students' perceived self-efficacy differ by gender?
3. How do students' perceived self-efficacy impact their science identity? Do differences exist by gender?

Recognizing that male and female students may report identifying as a scientist and self-efficacy levels differently by major, comparisons are made between respondents who report their current major in the following STEM fields:

1. Physical Science, Computer Science, Math and Engineering (PSCSME)
2. Agricultural and Biological Sciences (ABS)
3. Health Sciences and Psychology (HSP)

At times, comparisons are also made to students in Non-STEM majors. This type of major field disaggregation contributes to understanding specific nuances between various STEM majors, rather than treating the fields, as well as students' experiences and perceptions in the fields as homogenous.

Participants

Over 2,500 students began the survey. However, the analysis for this paper is restricted to the 1,881 students who completed the survey, are domestic students, and provided a university email address at one of the nine universities included in the study. Table 1 summarizes the participants' profiles. A greater percentage of women than men completed the survey (61.2 percent versus 38.1 percent, respectively). The racial and ethnic profile of the survey participants are reflective of the composition of the campuses included in the study: 72.4 percent were white (not Hispanic), 11.6 percent were Asian or Pacific Islander, 4.7 percent were Hispanic or Latino, 4.3 percent were Black (not Hispanic), and 0.6 percent were Native American or Alaskan Native. An additional 3.7 percent identified as another race or ethnicity, which included students who identified as biracial, and 2.8 percent of students preferred not to indicate their race or ethnicity. Over 12 percent of students were first-generation students. Sixty two percent of students reported that their father had a bachelor's degree or higher, and 56 percent reported that their mother had a bachelor's degree or higher.

Regarding their postsecondary experiences and status, 15.3 percent of respondents were freshman, 20.9 percent were sophomores, 28.6 percent were juniors, and 33.7 were seniors. The majority of student had not attended another university prior to their current institution (83.7 percent), while 7.9 percent previously attended a community college and 8.1 percent previously attended another four-year institution. Table 2 provides a summary of respondents' current major. The vast majority of students were in a science- or math-based major, with 37.5 percent in Engineering, 12.3 percent in the Biological Sciences, 10.4 percent in the Physical Sciences and Science Technologies, and 9.8 percent in the Health Sciences. In comparison, only 14.1 percent of respondents were in a Non-STEM field.

RESULTS AND DISCUSSION

Science Identity

The first research question was explored by using cross-tabulations between variables pertaining to science identity and gender. Results were disaggregated by STEM major categories. The following variables are highlighted: 1) Respondents comfort level in identifying as a scientist; 2) How faculty recognize respondents' as scientist; 3) Whether or not respondents had to work harder than their peers to be recognized as scientist; 4) Whether or not their field of study helps respondents identify as scientist; 5) Whether or not respondents identified as scientist; and lastly 6) Does seeing someone that looks like the respondent in their field reinforces their identity as a scientist.

Before turning to the individual results, it is important to not that statistically significant differences were found in men and women's science identity index score ($x^2(12, N = 1{,}881) = 35.435, p < .01$). A slightly greater percent of men had a very low level of science identity as compared to women (9.5 percent versus 7.4 percent, respectively). Forty-two percent of women and 35 percent of men had a low level of science identity, while 31 percent of women and 34 percent of men had a high level of science identity. Only ten percent of women and 7.4 percent of men had a very high level of science identity.

The most intriguing and statistically significant findings of the individual variables are highlighted. First, students were asked the extent to which they are comfortable identifying as a scientist. Gender differences in responses to this question were only statistically significant for students in PSCSME at the $p< 0.01$ level. Within PSCSME, 28.8 percent of men and 25.6 percent of women strongly agreed with this statement ($x^2(12, N = 1{,}881) = 42.079, p < .01$). Differences that were found to exist between males and females currently majoring in ABS or

HSP were statistically significant at the $p<0.05$ level. For students within ABS majors, 18.8 percent of men and 26.2 percent of women disagreed with this statement, while 43.8 percent of men and 37.1 percent of women agreed ($x^2(12, N = 1{,}881) = 24.336, p < .05$). Within HSP, 22.6 percent of men strongly agreed with the statement, as compared to only 7.7 percent of women. Another 48 percent of men agreed with being comfortable identifying as a scientist, compared to 35.7 percent of women ($x^2(6, N = 1{,}881) = 14.236, p < .05$). More often than not, a higher percentage of men felt comfortable identifying themselves as scientist in comparison to women. In instances where both males and females did not feel comfortable identifying themselves as scientist, women had a higher percentage as comparison to males. It is important to note that there are only 31 men currently in HSP majors, indicating that the results should be interpreted with caution. Women who are in the health sciences and psychology fields may identify more as psychologists and more clinical scientists, than traditional scientists, which may impact their response to this statement.

Next, the researchers examined the extent to which faculty recognize the respondent as a scientist. Gender differences were only statistically significant at the $p<0.01$ level for students who currently major in PSCSME, and at the $p<0.05$ level for students who currently major in ABS. Of PSCSME students, 36.5 percent of men and 40.9 percent of women agree ($x^2(12, N = 1{,}881) = 42.612, p < .01$). An additional 15 percent of men and women, respectively, strongly agree with this statement. The design of the survey does not allow for this theory to be investigated, but the differences in responses between men and women who agree with the statement may be due to more men identifying more as engineers, while women may identity with another profession. Within ABS majors, 45 percent of men agree or strongly agree with the

statement, as compared to 46 percent. While the differences are minimal, they are statistically significant ($x^2(12, N = 1{,}881) = 25.211, p < .05$).

Respondents were also asked if they had to work harder than their peers to be recognized as a scientist due to their gender. Interestingly, gender differences for students within ABS majors were found to be statistically significant at the $p<0.01$ level ($x^2(12, N = 1{,}881) = 228.486, p < .01$). Within ABS, slightly more than half of men strongly disagreed with this statement, versus only 18 percent of women. Only 7 percent of men agreed that they had to work harder than their peers due to their gender, as compared to 35 percent of women. An additional 2 percent of men and 12 percent of women within ABS strongly agreed with the statement. Differences by gender within PSCSME majors was statistically significant at the $p<0.05$ level ($x^2(12, N = 1{,}881) = 23.068, p < .05$). Far more women agreed and strongly agreed with this statement, as compared to men: 27.9 percent of women versus 9.6 percent of men. Differences by gender were statistically insignificant for students in HSP majors.

Respondents were then asked whether or not their field of study helps them identify as scientist. Statistical significance was found between the genders within PSCSME majors at the $p<.0.01$ level. The results show that a higher percentage of men than woman agreed that their field of study within PSCSME helps them identify as a scientist. Within PSCSME, 51.9 percent of men and 48.4 percent of women agreed with this statement ($x^2(12, N = 1{,}881) = 54.686, p < .01$). For other relative major categories no statistical significance were found.

Additional science identity constructs that were examined asked respondents whether or not they identified as scientist. Gender differences were found between PSCSME and ABS majors. Within PSCSME, gender differences were found to be statistically significant at the $p<0.01$ level. Interestingly, 25 percent of men disagreed with this statement versus 16.7 percent

of women ($x^2(12, N = 1{,}881)=46.758, p < .01$.) However this difference can possibly be explained by how males and females classify themselves. It could be the case that men chose to identify more as an Engineer, Mathematician and or Computer Scientist, which may impact their response to this statement. The differences found between males and females currently majoring in ABS were statistically significant at the $p<0.05$ level. Forty-three percent of men agreed to this statement while 38.1 percent of women agreed to this statement ($x^2(12, N = 1{,}881) = 28.915, p < .05$). As stated previously, women may classify themselves as something other than a biologist rather than traditional scientist, which may impact this statement. For other relative major categories no statistical significance were found.

Respondents where also asked if seeing other people who looks like them in their field reinforces their identity as a scientist. The gender differences in responses to this question were statistically significant for students in PSCSME at the $p< 0.01$ level. Of men within PSCSME 16.3 percent strongly disagreed while 14 percent of women strongly disagreed to this statement ($x^2(12, N = 1{,}881) = 43.200, p < .01$). Thus a slightly higher percentage of men disagreed with this statement in comparison to women. Statistical significance between genders were also found within ABS at the p<0.05 level. Within ABS majors, 27.1 percent of men disagreed while 34.6 percent of women disagree to this statement (x2(12, N = 1,881) = 23.734, p < .05). In this case more women than men within ABS finding suggests that women in ABS major fields do not need someone who looks like them within their field to reinforce their identity as a scientist. Differences that were found to exist between males and females currently majoring in HSP were statistically significant at the $p<0.05$ level. For students within HSP majors, 6.5 percent of men and 15.4 percent of women strongly disagreed, 22.6 percent of men and 40.1 percent of women disagreed, 35.5 percent of men agreed where as 18.7 percent of women agreed, and lastly 19.4 of

men strongly agreed, while 3.8 percent of women strongly agreed ($x^2(12, N = 1{,}881) = 19.535$, $p < .05$). This finding suggests that women in HSP major fields do not need someone who looks like them within their field to reinforce their identity as a scientist, possibly reflecting the fact that HSP fields are predominately female The results also suggest that men in HSP major fields need someone within that field who looks like them reinforce their identity as a scientist, which may also reflect that they may not find people in their field that look like them, given that the HSP fields are predominately female. However, these results should be interpreted with caution given that there are only 31 respondents were male majoring in HSP.

Self-Efficacy

The second research question was also explored by using cross-tabulations between variables pertaining to self-efficacy and gender. To capture the concept of self-efficacy, we looked at student's capabilities and how they feel about themselves. As with the first research question, the results were also disaggregated by gender and by STEM major categories. Although all of the self-efficacy variables listed in Appendix A were investigated, the only variables highlighted in this section are 1) Students self-reported confidence level in math and science skills; 2) How students feel about themselves; and 3) Whether or not students expected to be honor students.

Before the individual variables are discussed, it is important to note that differences by gender were also found in the self-efficacy composite score. Very few male and female students had very low levels of self-efficacy (0.4 percent and 0.5 percent, respectively). A slightly larger percentage of women had a low-level of self-efficacy as compared to men (31.5 percent and 28.9 percent, respectively). Sixty-three percent of men had a high-level of self-efficacy, while 4.5 percent of men had a very high-level of self efficacy. In comparison, 64.4 percent of women had

a high-level of self-efficacy, while only two percent had a very high-level of self-efficacy. These differences were found to be statistically significant ($x^2(12, N = 1{,}881) = 81.92, p < .05$).

One measure of self-efficacy that was examined was students' self-reported confidence levels in their math and science skills. Differences between men and women were only statistically significant for students who majored in PSCSME ($x^2(8, N = 1{,}881) = 22.769, p < .01$). Within PSCSME, 71 percent of men reported being very confident in their math and science skills, as compared to only 47 percent of women. In addition, 23 percent of men reported being somewhat confident in their math and science skills, as compared to 44 percent of women. Gender differences in these confidence levels were not statistically significant in the ABS or HSP fields.

Another indicator of self-efficacy asked students how they felt about themselves. Differences between men and women who majored in PSCSME was significant at the $p < 0.01$ level. Within PSCSME 43.3 percent of men versus 32.1 percent of women strongly agreed to this statement ($x^2(8, N = 1{,}881) = 38.493, p < .01$). Further, differences were found to exist between males and females currently majoring in ABS were significant at the $p < 0.01$ level. Men strongly agreed at a slightly higher percentage than women. Within ABS 37.4 percent of men and 35.9 percent of women strongly agreed to this statement ($x^2(8, N = 1{,}881) = 38.900, p < .01$). In addition, differences that were found to exist between males and females currently majoring in HSP were statistically significant at the $p<0.05$ level. Interestingly, we see a robust increase in women feeling good about themselves within the HSP majors. Within HSP 45.2 percent of men agreed to this statement, versus 69.2 percent of women who agreed to this statement ($x^2(12, N = 1{,}881) = 18.822, p < .05$).

Finally, respondents where asked whether or not they expected to be an honors student at their college or university. Differences between men and women were statistically significant for students who majored in PSCSME ($x^2(8, N = 1{,}881) = 64.958, p < .01$). Within PSCSME 26.9 percent of men disagree versus 34.9 percent of women who disagreed with this statement, while 35.6 percent of men agreed versus 23.3 percent of women strongly agreed with this statement. The findings suggest that men had higher expectations of being an honors student at their college or university, while women on the other hand had lower expectations of being honor students. In addition while both male and females disagreed with this statement, a higher percentage of women did not expect to be honor students within PSCSME major fields.

Regression Results

The last research question examines how students' self-efficacy impacts science identity. A composite score created from the variables that comprise the first factor identified in PAF analysis serves as the dependent variable. The independent variables were recoded to be binary, with those derived from Likert Scales to compare Agree and Strongly Agree[3] responses with all other possible responses. Each model used in the analysis built upon the previous model, incorporating additional variables, beginning with self-efficacy variables. Table 6 provides the regression results for each model. Across the seven models reported, R^2 increased from 0.068 to 0.278, indicating that approximately 28 percent of the variance found in the science identity composite score is explained by the variables included in the final model.

In the final model, only one variable pertaining to self-efficacy were statistically significant at the $p<0.05$ level, *ceteris paribus*. Believing that new students like themselves don't do well at their college or university lowered the science identity composite score by 0.226.

[3] Items that were negatively-oriented were recoded to compare Disagree and Strongly Disagree with all other responses.

Several other factors included in the model were statistically significant. The factor of using and doing science, saved from the PAF analysis for the purpose of the regression analysis, was statistically significant, and had a positive impact on science identity (β=0.495). Being very confident in math and science skills increased the science identity score by 0.149, while having to work harder than peers to be recognized as a scientist because of gender lowered science identity by 0.673. Interestingly, majoring in PSCSME and ABS increased science identity by 0.277 and 0.150, respectively, while majoring in HSP was not statistically significant.

From the regression, there is an overall weak association between students' self-efficacy and science identity. Instead, it appears that using and doing science—actual actions pertaining to and applications of scientific skills and knowledge—have a greater impact on science identity. In this sense, doing and using science strengthens a student's science identity much more than beliefs about hard work and good luck. Faculty and staff in STEM fields who wish to foster students' science identities should work to provide opportunities to conduct research and apply scientific knowledge and skills.

The regression results also support some of the findings from the cross-tabulations, particularly the notion that majoring in certain STEM fields over others can have an impact on students' science identity and self-efficacy. The regression results inform us that being in the health sciences and psychology does not have a statistically significant impact on students' science identity. As mentioned previously, students who major in HSP may identify more as pre-med, a psychologist, or another identity that is more oriented towards their future as a professional in the clinical sciences. On the other hand, majoring in either PSCSME or ABS has a positive impact on science identity, yet it is unknown within these major categories which majors offer the largest impact. In other words, students who major in the physical sciences may

have an even stronger science identity than those majoring in engineering. This represents an area for additional inquiry in future research.

Recall that one of the main purposes of this paper was to determine differences in science identity between men and women. Being female was only statistically significant in Model 6, where R^2 was 0.243. In Model 6, being female had a negative impact on science identity. However, in the final model which had the highest R^2 value, being female was not statistically significant. However, having to work harder than peers to be recognized as a scientist was found to have a negative and statistically significant impact on science identity. This finding, along with the findings from the use of the female variable, indicate that simply being female may not matter in terms of identifying as a scientist, yet how women perceive being compared to their male counterparts may impact how female students' identify as a scientists and the extent to which they see others recognizing them as a scientist. This may point to evidence of perceived and/or actual differences in treatment by gender within the STEM fields.

LIMITATIONS

While the results of the study are interesting, there are a number of limitations in the study. Although the data has been aggregated across all nine participating campuses, some universities had more students participate in the survey than others, which may impact the results. In other words, the measures of science identity and self-efficacy may be indicative of students at particular universities within the nine campuses featured in the study. However, the researchers determined that aggregation across institutions strengthened the data in terms of having enough observations of men and women within a variety of STEM majors.

In addition, an effort was made to gather data from students in non-STEM majors, for comparative purposes. However, of the 1,881 responses, only 14.1 percent of respondents reported their current major as being in a non-STEM field. Thus, the ability to compare the results is somewhat limited between STEM and non-STEM majors. This is primarily a limitation with the self-efficacy questions, rather than with the issue of science identity, based on the assumption that most non-STEM students would not identify as a scientist.

Although this study focuses on science identity and self-efficacy, these topics of interest were derived from a larger, lengthy survey, which may have discouraged some students from completing the survey. Specifically, over 800 students began but did not complete the survey. This may have been due to the length of the survey, as well as the inability of students to begin taking the survey, save their responses, and return to complete the survey at a later time, given that unique URLs for the survey were not provided to participants. In addition, as demographic information was gathered at the end of the survey, the researchers are unable to create a profile of the students who began but did not complete the survey.

Pertaining to the questions of science identity, students were only asked about identifying as a scientist. However, students in certain STEM majors may not identify as a scientist, but rather as an engineer, a mathematician, or a psychologist. Adding a question or set of questions prior to the questions on science identity that ask how students academically or professionally identify themselves may strengthen the survey. In addition, the survey design did not allow for comparative data to be gathered determining the extent to which undergraduate students even see themselves as scientists, versus simply identifying as a college student or as something else. Having access to longitudinal data, as well as data from multiple cohorts at different educational stages, may help understand when science identity development begins and when it accelerates.

On a related note, the survey did not ask students questions about what it means to be a scientist. A student who has a strong science identity may have a different conceptualization of what it means to be a scientist as compared to a student with a different level of science identity. Although there are limitations in the study, a number of them may be addressed in future research, which will be discussed below.

IMPLICATIONS AND CONCLUSION

Implications

The findings from this study provide information that can assist program directors and administrators in establishing programs that aim to foster science identity development. Recall that the variables pertaining to science identity highlighted in the discussion included: 1) Respondent's comfort level in identifying as a scientist;] 2) How faculty recognize the respondent as scientist; 3) Whether or not respondents had to work harder than their peers to be recognized as scientist; 4) Whether or not their field of study helps respondents identify as scientist; 5) Whether or not respondents identified as scientist; and lastly 6) Seeing someone that looks like the respondent in their field reinforces their identity as a scientist. Gender differences in science identity, specifically whether or not students were comfortable with identifying themselves as scientist, were found to exist within students majoring in PSCSME, ABS, and HSP. Men typically had a higher percentage of feeling comfortable indentifying as a scientist in comparison to women. Further inquiry will allow the researchers to ask respondents more in-depth questions to assess their reasoning behind their comfort level of identifying as a scientist. Moreover, gender differences in being recognized as a scientist were also found to exist within

students majoring in PSCSME and ABS. This finding also prompts the researchers to ask more in-depth questions to examine this gender dynamic within these fields.

An unexpected finding that deserves attention is the fact that men within HSP reported needing someone within that field to reinforce their science identity. This finding brings light to an area of study that would benefit from additional investigation, particularly in terms of studying the impact of female-dominated fields on male students' science identity and science identity development. This study and others similar to it, suggest implications that insinuate more inclusion and understanding of gender dynamic in the workforce. To help mediate this understanding, much policy and practice needs to be employed earlier on to break down gender stereotypical barriers within STEM major fields and careers. While more women are becoming biologist, engineers, and chemists, while men are entering health science fields, more discussion to help eliminate stereotypical roles in those work settings will enable program directors and administrators assist men and women in developing a science identities in fields that are not the typical norm for their gender.

Turning now to the implications for self-efficacy, recall that the variables pertaining to self-efficacy highlighted in the study included: 1) students self-reported confidence level in math and science skills; 2) How students feel about themselves; and 3) whether or not students expected to be honor students. Similar to the gender differences found in students' identifications a scientist, a higher percentage of men had stronger sense of self-efficacy as compared to women. Interestingly women within PSCSME and ABS had a higher percentage than men when asked how they felt about themselves, on the other hand within HSP women had a higher percentage than men. Additional questions in the follow-up survey will also for this finding be examined further.

Overall, considering gender in the development of science identity and self-efficacy suggests that program directors and administrators in postsecondary institutions, should consider encouraging students to understand scientific skills and knowledge that will enable them to embrace identifying as a scientist in a STEM related field. . Further self-efficacy and science identity should be holistically viewed to not only include looking at females in male dominated science related fields, but also looking at males in female dominated science fields. Interestingly, this finding supports research that suggest some occupations are perceived as being stereotyped by gender, with some occupations and majors perceived as being better suited for men while others are better suited for women. Societal perception of professional careers has long been gender stereotyped, and through socialization and other processes, the experiences and choices that men and women make in regards to their undergraduate major can be impacted. This in turn, may further impact the science identity and science identity development for students in STEM fields.

Regression analysis in this study finds that using and doing science had a positive impact on science identity. In addition being confident increased a student's science identity score. In essence, programs and support services should be established that would allow students to foster using and doing science while building confidence in math and science skills. Such efforts could possibly increase students' persistence in STEM majors and even careers, particularly if students are able to strengthen their science identity while in college. Moreover, the regression analysis found that majoring in PSCSME and ABS increased science identity, while in contrast, majoring in HSP does not have an impact on science identity. Placing this findings within the larger social context allows may give insight into how society visualizes, perceives, and internalizes what is

considered science, what a scientist is, and what fields are not included and excluded in the definition of STEM.

Future Research

While this study addressed inquired research questions, it also left room for new ideas for future research. From the findings and analysis, it is suggested that future research will seek to gain a more in-depth understanding of how a student's sense of identity and self-efficacy changes over time. In addition, asking students for a definition or an explanation of what it means to be a scientist may be an opportunity for future research, as well as investigating how students' conceptualizations of scientists affects their own science identity. This will allows us to better understand students' perspective on the term and how they come to develop an identity within their science related field. Conducting additional analysis by incorporating other items within the survey, such as academic engagement and community engagement, will allow us to examine additional factors as they relate to students' science identity. In addition, investigating if students participated in college-preparatory programs related to STEM, (e.g., Mathematics, Engineering, Science Achievement (MESA)) have a higher level of science identity or not is another area of study worth researching.

While this study did not specifically seek to examine men's science identity in health related fields, the findings did suggest that within health related fields, significant gender differences exist. Interestingly, much research has given attention to women and their experience in hard sciences while little research covers science identity for men within health related fields. In fact, Evans (2004) assert that a "review of the literature in health professions, and nursing in particular, reveals that little research has examined the experience of men and how men's bodies and dominant social constructions of masculinity shape the experience of men as members of a

numerically female-dominated health profession" (pg 15). This notion can be attributed to the fact that health fields tend to be dominated by women, while hard STEM areas tend to be dominated by men. An unexpected finding, as well as a future line of research is to expand on the current literature of men's underrepresentation in the health fields and how men develop science identities in health related majors and practices.

Finally, the findings lend themselves to a possible future qualitative study, specifically interviewing undergraduate students to allow for a more in-depth analysis of factors that contribute to students' perceived self-efficacy and science identity. Future research should focus on all components of gender differences in all STEM related field majors and professions to have holistic approach on the development of science identity for both male and females.

Conclusion

As society seeks to increase representation of underrepresented minorities in the STEM fields, it is critical to understand underlying factors that influence students' enrollment and persistence in science- related fields. While students self-select their majors based on a wide variety of reasons, understanding how students in the STEM fields identify with the discipline of science may help to explain differential outcomes by gender, race and ethnicity, and other factors.

This study has allowed us to examine components of science identity that could help explain how students identify with science as a whole, how others perceive them as scientists, and what factors impact students' identifying as a scientist. The study found gender differences do exist between male and females in terms of their science identity. We also shed light on new research that will ideally contribute to the growing body of literature on science identity with respect to gender, as well as further understandings of differential rates by gender of students'

participation and persistence in the sciences. From the onset, ideal implications should employ programs that will encourage self-efficacy, and further provide opportunities to genders in fields where they constitute the minority.

Considering identity formation is "significant during college because the late adolescent years (e.g., 18 to 22) are regarded "as a crucial time for identity formation" (Muuss, 1996, p. 62), it becomes critical for postsecondary institutions to examine and employ efforts where students experience much growth. College is a time where students are exposed to different course content and can develop knowledge and skills in any given subject area. Thus, it remains important to consider the role of postsecondary institutions and their role on helping students in the STEM develop a science identity.

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Appendix A: Details of Survey Items and Factors Used in Analysis

Self-Efficacy (Cronbach's Alpha=0.924)
I feel good about myself
I don't have enough control over the direction my life is taking
I feel I am a person of worth, the equal of other people
I am able to do things as well as most other people
Every time I try to get ahead, something or somebody stops me
My plans hardly ever work out, so planning only makes me unhappy
Students like me do not usually do well at this college/university
I expect to be an honors student at this college/university
I could get higher grades in a major that suited me better
I am afraid I may not make it in college or in a university
On the whole, I am satisfied with myself
I feel useless at times
At times, I think I am no good at all
When I make certain plans, I am almost certain I can make them work
I feel I do not have much to be proud of
In my life, good luck is more important than hard work for success
Chance and luck are very important for what happens in my life

Identifying As a Scientist (Cronbach's Alpha=0.940)
I identify as a scientist
I am comfortable identifying myself as a scientist
Field of study helps me identify as a scientist
My faculty recognize me as a scientist
My peers recognize me as a scientist
My family and friends recognize me as a scientist
It is important to me that others see me as a scientist
Seeing other people who look like me within my field reinforces my science identity

Using and Doing Science (Cronbach's Alpha=0.831)
Doing science is important to who I am
My knowledge and skills will allow me to help others
My knowledge and skills will allow me to contribute to social issues that are important to me
I enjoy conducting research

Appendix B: Tables

Table 1

Demographic and Background Information of Survey Respondents (n=1,881)

Variables	N	%
Gender		
Male	716	38.1%
Female	1151	61.2%
Prefer not to Answer	14	0.7%
Race and Ethnicity		
White not Hispanic	1361	72.4%
Asian or Pacific Islander	218	11.6%
Hispanic or Latino/a	89	4.7%
Black, not Hispanic	81	4.3%
Other Race/Ethnicity	69	3.7%
Prefer not to Answer	52	2.8%
Native American or Alaskan Native	11	0.6%
First-Generation Status		
Yes	231	12.3%
No	1639	87.1%
Prefer not to Answer	11	0.6%
Class Status		
Freshman	288	15.3%
Sophomore	393	20.9%
Junior	538	28.6%
Senior	633	33.7%
Prefer not to Answer	29	1.5%
Transfer Status		
Transferred from a Community College	149	7.9%
Transfer From another Four Year Institution	152	8.1%
Did not Transfer	1575	83.7%
Prefer not to Answer	5	0.3%

Source: Project STEP-UP Survey, 2011; Authors' Calculations.

Table 2

Respondents' Current Major

	Gender			
	Male	Female	Prefer not to Answer	Total
Agricultural Sciences	17	72	0	89
	2.4%	6.3%	0.0%	4.7%
Biological Sciences	87	143	2	232
	12.2%	12.4%	14.3%	12.3%
Computer Information Sciences & Technologies	38	30	1	69
	5.3%	2.6%	7.1%	3.7%
Engineering & Engineering Technologies	279	433	7	719
	39.0%	37.6%	50.0%	38.2%
Health & Clinical Sciences	24	160	0	184
	3.4%	13.9%	0.0%	9.8%
Mathematics & Statistics	20	25	0	45
	2.8%	2.2%	0.0%	2.4%
Natural Resources & Conservation	19	34	0	53
	2.7%	3.0%	0.0%	2.8%
Physical Sciences & Science Technologies	91	100	4	195
	12.7%	8.7%	28.6%	10.4%
Psychology	7	22	0	29
	1.0%	1.9%	0.0%	1.5%
Non-STEM	134	132	0	266
	18.7%	11.5%	0.0%	14.1%
Total	716	1151	14	1881
	100.0%	100.0%	100.0%	100.0%

Source: Project STEP-UP Survey, 2011; Authors' Calculations.

Table 3.

Science Identity

	Major	Gender	Strongly Disagree	Disagree	Agree	Strongly Agree
I am comfortable identifying myself as a scientist	PSCSME	Male	1.0%	19.2%	38.5%	28.8%
		Female	2.8%	20.9%	40.5%	25.6%
	ABS	Male	6.5%	18.8%	43.8%	18.1%
		Female	4.5%	26.2%	37.1%	19%
	HSP	Male	3.2%	16.1%	48%	22.6%
		Female	6.6%	35.2%	35.7%	7.7%
My faculty recognize me	PSCSME	Male	2.9%	31.7%	36.5%	14.4%
		Female	4.7%	23.3%	40.9%	15.3%

My faculty	PSCSME	Male	2.9%	31.7%	36.5%	14.4%
		Female	4.7%	23.3%	40.9%	15.3%
I have to work harder than my peers to be recognized as a scientist due to my gender	ABS	Male	8.3%	25.5%	36.2%	8.7%
		Female	5.1%	30.1%	36.7%	9.3%
	PSCSME	Male	2.9%	29.8%	39.4%	17.3%
		Female	4.7%	23.3%	44.7%	15.3%
	ABS	Male	8.3%	23.9%	40.3%	10.1&
		Female	5.3%	27.2%	39.2%	11.7%
Field of study helps me identify as a scientist	PSCSME	Male	1.9%	10.6%	51.9%	27.9%
		Female	2.3%	11.2%	48.4%	28.4%
I identify as a scientist	PSCSME	Male	1.9%	25%	37.5%	27.9%
		Female	3.7%	16.7%	44.7%	23.3%
	ABS	Male	7.6%	21%	43.4%	16.8%
		Female	5.3%	26.8%	38.1%	18.2%
	PSCSME	Male	16.3%	35.6%	24%	8.7%
		Female	14%	34.9%	25.6%	7.4%
Seeing other people who look like me within my field reinforces my science identity	ABS	Male	21.5%	27.1%	23.3%	6.7%
		Female	17.8%	34.6%	21.4%	6.4%
	HSP	Male	6.5%	22.6%	35.5%	19.4%
		Female	15.4%	40.1%	18.7%	3.8%

Source: Project STEPUP, 2011; Author's calculations.

Table 4.

Self-Efficacy

Variable	Major	Gender	Strongly Disagree	Disagree	Agree	Strongly Agree
	PSCSME	Male	2.9%	5.8%	43.3%	43.3%
		Female	2.8%	6.5%	54.4%	32.1%
	ABS	Male	2.0%	7.2%	48.8%	37.4%
		Female	1.0%	5.8%	54.8%	35.9%
		Male	6.5%	9.7%	45.2%	35.5%

		Female	0.0%	2.7%	69.2%	24.7%
I expect to be an honors student at this college/university	PSCSME	Male	9.6%	26.9%	19.2%	35.6%
		Female	11.2%	34.9%	20.5%	23.3%

Source: Project STEPUP, 2011; Author's calculations.

Table 5.

Confidence in Math and Science Skills

Variable	Major	Gender	Not at All	A Little	Somewhat	Very Much	Prefer Not to Answer
Confidence in Math and Science Skills	PSCSME	Male	1.0%	3.8%	23.1%	71.2 %	
		Female	1.4%	7.4%	44.2%	47.0 %	

Source: Project STEPUP, 2011; Author's calculations.

Table 6.

Regression Results for Science Identity

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
(Constant)	4.268	4.818	3.878	4.886	4.783	4.817	4.045	3.879	3.917
	(0.116)	(0.118)	(0.109)	(0.115)	(0.123)	(0.124)	(0.109)	(0.118)	(0.120)
Feel good myself	0.197	0.218**	0.213**	0.204	0.195	0.199	0.198	0.192	0.195
	(0.119)	(0.112)	(0.109)	(0.108)	(0.108)	(0.108)	(0.105)	(0.105)	(0.105)
Good luck is important	-0.285**	-0.160	-0.162	-0.115	-0.120	-0.109	-0.115	-0.121	-0.112
	(0.102)	(0.096)	(0.094)	(0.093)	(0.093)	(0.093)	(0.090)	(0.090)	(0.090)
Person of worth	-0.277**	-0.226**	-0.163	-0.233	-0.237**	-0.231**	-0.175	-0.185	-0.180
	(0.116)	(0.109)	(0.107)	(0.105)	(0.105)	(0.105)	(0.102)	(0.102)	(0.102)
Do things as well as others	-0.228	-0.203	-0.164	-0.183	-0.178	-0.187	-0.145	-0.137	-0.145
	(0.120)	(0.113)	(0.111)	(0.109)	(0.109)	(0.109)	(0.107)	(0.107)	(0.107)
Expect to be an honors student	-0.067	-0.052	-0.079	-0.063	-0.074	-0.068	-0.087	-0.094	-0.089
	(0.057)	(0.054)	(0.053)	(0.052)	(0.052)	(0.052)	(0.051)	(0.051)	(0.051)
Satisfied with myself	-0.221**	-0.200	-0.207**	-0.174	-0.170	-0.168	-0.178	-0.176	-0.174
	(0.115)	(0.108)	(0.106)	(0.104)	(0.104)	(0.104)	(0.101)	(0.101)	(0.101)
Make plans work	0.099	0.071	0.089	0.056	0.056	0.054	0.073	0.070	0.068

	(0.083)	(0.078)	(0.076)	(0.075)	(0.075)	(0.075)	(0.073)	(0.073)	(0.073)
Don't have control over life	0.082	0.084	0.078	0.123	0.128	0.129	0.117	0.123	0.124
	(0.079)	(0.074)	(0.073)	(0.072)	(0.072)	(0.072)	(0.070)	(0.070)	(0.070)
Something stops me from getting ahead	-0.018	-0.020	0.032	-0.021	-0.026	-0.022	0.024	0.022	0.025
	(0.090)	(0.084)	(0.082)	(0.081)	(0.081)	(0.081)	(0.079)	(0.079)	(0.079)
Planning makes me unhappy	-0.076	-0.045	-0.083	-0.020	-0.021	-0.016	-0.054	-0.059	-0.055
	(0.104)	(0.098)	(0.096)	(0.094)	(0.094)	(0.094)	(0.092)	(0.092)	(0.092)
Students like me usually don't do well at this college or university	-0.292**	-0.224**	-0.262**	-0.190**	-0.195**	-0.188**	-0.226**	-0.232**	-0.226**
	(0.089)	(0.084)	(0.082)	(0.080)	(0.080)	(0.080)	(0.078)	(0.078)	(0.078)
Get higher grades in a different major	-0.025	-0.025	-0.059	0.026	0.022	0.023	-0.003	-0.005	-0.004
	(0.063)	(0.059)	(0.058)	(0.057)	(0.057)	(0.057)	(0.056)	(0.056)	(0.056)
Afraid not going to make it in college	-0.121	-0.036	-0.131	0.010	0.023	0.023	-0.075	-0.058	-0.057
	(0.094)	(0.089)	(0.087)	(0.086)	(0.086)	(0.086)	(0.084)	(0.084)	(0.084)
Feel useless at times	0.051	0.025	-0.008	0.053	0.054	0.051	0.023	0.023	0.022
	(0.084)	(0.079)	(0.077)	(0.076)	(0.076)	(0.076)	(0.074)	(0.074)	(0.074)
Feel no good at all	0.014	0.001	0.001	0.037	0.043	0.038	0.037	0.046	0.042
	(0.087)	(0.082)	(0.080)	(0.079)	(0.079)	(0.079)	(0.077)	(0.077)	(0.077)
Do not have much to be proud of	0.005	.081	.007	.073	.066	.069	.008	.003	.006
	(0.096)	(0.090)	(0.088)	(0.087)	(0.087)	(0.087)	(0.085)	(0.085)	(0.085)
Chance and luck are very important	-0.159**	-0.145**	-0.126**	-0.120	-0.139	-0.127	-0.104	-0.121**	-0.112
	(.071)	(0.067)	(0.065)	(0.065)	(0.064)	(0.063)		(0.063)	(0.063)
Doing science is important		0.352**		0.313**	0.297**	0.298**			
		(0.061)		(0.059)	(0.060)	(0.059)			
Scientific knowledge and skills will help others		-1.283**		-1.102**	-1.123**	-1.106**			
		(0.117)		(0.113)	(0.113)	(0.114)			
Scientific knowledge and skills will help social issues'		-0.156		-0.176**	-0.191**	-0.182**			
		(0.094)		(0.090)	(0.090)	(0.090)			
Enjoy conducting research		-0.011		0.014	0.017	0.011			
		(0.062)		(0.060)	(0.059)	(0.059)			
Using and Doing Science (Factor)			0.535**				0.488**	0.501**	0.495**
			(0.030)				(0.029)	(0.029)	(0.029)

Very Confident in Math and Science Skills		0.173**	0.181**	0.157**	0.174**	0.156**	0.168**	0.163**	0.149**
		(0.055)	(0.054)	(0.054)	(0.055)	(0.055)	(0.052)	(0.053)	(0.054)
Work harder than peers to be recognized as a scientist because of gender				-0.668**	-0.651**	-0.681**	-0.661**	-0.649**	-0.673**
				(0.055)	(0.053)	(0.055)	(0.053)	(0.052)	(0.054)
Female				-0.094		-0.114**	-0.075		-0.090
				(0.055)		(0.056)	(0.054)		(0.055)
PSCSME Major					0.193**	0.213**		0.261**	0.277**
					(0.092)	(0.092)		(0.088)	(0.089)
ABS Major					0.070	0.079		0.143**	0.150**
					(0.076)	(0.076)		(0.074)	(0.074)
HSP Major					0.107	0.141		0.086	0.114
					(0.101)	(0.102)		(0.097)	(0.099)
R-squared	0.068	0.179	0.213	0.241	0.242	0.243	0.274	0.277	0.278
Adjusted R-squared	0.060	0.169	0.205	0.231	0.231	0.232	0.266	0.268	0.269
No. observations	1,881								

Source: Project STEPUP, 2011; Author's calculations.

*No*tes: Standard deviations are reported in the parenthesis. ** indicates significance at the p<0.05 level