A Mixed Methods Analysis of Goals and the Impact of Peer Mentoring for Participants in the WISE Honors Program

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A Mixed Methods Analysis of Task Values and Achievement Goals for Participants in the WISE Honors Program

Mastery vs. performance oriented goals may elicit different motivational patterns and reasons behind approach, engagement, and integration in achievement activities and learning environments. This study examined the freshmen learning environment for $N = 60$ female members of the Women in Science and Engineering (WISE) Honors program at a large Northeastern university to explore the impacts of a formal peer mentoring program on goal setting and achievement. Competency, task values, and achievement goals were measured by a survey adapted from *Assessing Women and Men in Engineering* ($\alpha = .77$). A multiple regression analysis was used to predict achieving success in their major career from leisure time spent with women in STEM majors, having many friends studying in their discipline, confidence in completing a science/engineering degree, impact of high school coursework, and not having to give up extracurricular activities. The multiple regression was significant, $F(5,48) = 9.82$, $p < .001$, adj. $R^2 = .45$, with significant contributions from social structures, competency in prior course work, and continued involvement in extracurricular activities. Qualitative analysis of goals revealed that 55% reported mastery related goals, and 29% responded with a performance-based approach. 70% of responses reported having social goals related to relationships, with 57% of responses indicating academic based goals for increased knowledge, opportunities, and successful completion of degrees. Findings indicate that the majority of goals were mastery oriented which may promote retention of female undergraduates in science and engineering majors.

Introduction

There has been a lack of understanding regarding how and why students choose and persist in engineering degrees. To address the stagnant enrollment and attrition of women in post-secondary STEM (science, technology, engineering, and mathematics) degree programs [1], the present study examines expectancy-values and the utility of achievement goals for freshman female STEM majors in a large, Northeastern research university. Expectancy-value models have been used extensively as a conceptual framework for explaining motivational processes in academic and career trajectories [2]. The *expectancy* component corresponds to beliefs about one's own competence and self-efficacy whereas the *value* component refers to the reasons for engaging in a specific task. Expectancy value theorists have posited that values such as interest, social relevance, cost, and attainment describe how individuals assign a level of relative importance in activity engagement [3].

Eccles defined task values as the individual’s incentives for engaging in different tasks or activities based on the nature of the task and how well it is aligned with personal values, goals, and needs [3]. There are four categories of task values: attainment value, the perception of how performance on a task reflects on the individual; intrinsic value, the enjoyment experienced while engaging in a task; utility value, the perceived future importance of engaging in the task; and cost, the price of success or failure in terms of effort, time, and/or psychological impact. This model is based upon the perception of an individual’s abilities and task values that shape engagement and persistence behaviors. Therefore, expectancy appears to be influenced by competency beliefs. Value refers to a students' interest in the subject and the given tasks, as well as utility value, personal goals, and cost [2]. Expectancy-value theory provides a framework for the study of educational and career choice based on competency, expectancies, task values, and goals. When individuals feel confident they can learn and be successful in particular subject areas, they are more likely to persist and engage in cognitive strategies associated with increased academic achievement. Value related beliefs are predictive of achievement and engagement but may be stronger predictors of career aspirations in STEM [4]. Motivational beliefs, which are informed by aptitudes in mathematics and science, competence beliefs, interest, and career goals, play a large role in the decision to pursue and persist in STEM fields [5], [6].

Research in understanding how learning environments may be structured to aid achievement motivation and persistence span multiple perspectives from achievement goal theory [7], social cognitive theory [8], to self-determination theory [9]. Learning environments may stress the importance of competencies and/or outperforming others [7]. Achievement goal theory proposes two main goal orientations that influence individuals' interpretations and reactions to achievement situations [7], [10]. A mastery goal orientation refers to the development of competence and interest in learning new skills, and performance goal orientations focus on demonstration of competence by outperforming others [10], [11]. In the motivational literature, the term *goal* is used to designate a complex set of processes or specific outcomes [12]. Elliot and Thrash defined a goal in terms of outcomes with competence as the objective in persistence and achievement [13]. Achievement goals may be viewed as competence-relevant behaviors with the primary emphasis on mastery goals and performance goals, where mastery goals are focused on the development of competence through task mastery versus performance goals focused on the demonstration of competence relative to others [14]. Competence is the core construct of achievement goal theory and may be defined according to task mastery or acquired understanding as a result of improvement of performance, or with a normative standard in performing better than others [13].

Achievement goals may act as a mediator between competency beliefs and achievement related behaviors [5]. Goal orientations include beliefs about the purposes of goals, and the meaning of success, ability, effort, and failure. The goals individuals adopt in learning settings have important implications for a wide range of academic behaviors. In general, a mastery focus is positively related to a preference for challenging activities, high levels of interest, engagement, and persistence [13], [15]. In contrast, O'Keefe et al., proposed that performance goal orientations are linked to beliefs about self-worth, contingent upon outperforming others as a means of demonstrating ability [16]. When students approach a task with mastery goal orientation, they seek challenge, persist in the face of difficulty, view mistakes as a learning opportunity, and tend to be more intrinsically motivated [11], [17], [18]. In contrast, the performance goal approach often shows patterns of task avoidance, mistakes equated with failure, and a decrease in self-efficacy and intrinsic motivation [18], [19]. Both performance approach and mastery approach focus on the attainment of competence to foster intrinsic engagement by facilitating task value [20].

Achievement goal theory and expectancy value theory suggest that STEM pathways are composed of a series of choices and achievement related behaviors directly related to expectations for success and the value attached to the available options in educational and career choices [5]. Expectancy value models have emphasized values in relation to achievement, but a gap remains in how values might be attached to goals or how the goals and cognitive strategies individuals adopt may mediate the role of values. Achievement goal models have ignored values and have not considered how goals may change if importance or utility are attached to mastery or performance goals [18]. A large body of literature supports expectancy-value theory and achievement goal theory in predicting achievement related behaviors; however, the relationship among achievement goals, expectancy-value, and achievement related outcomes, particularly for women in STEM, is not clear. The purpose of this study is to explore the relationships between social structures of a peer mentoring program, competency beliefs, task values, and achievement goals in women first-year science and engineering majors in an effort to increase retention of women in STEM majors.

Methods

Research context. The study participants ($N = 60$ females) were Women in Science and Engineering Honors (WISE) undergraduate first-year students declaring science ($n = 32$) or engineering ($n = 28$) majors at a research university in the 2017-18 academic year. This large research-intensive university enrolled 17,000 undergraduates, with slightly more than half in STEM-related disciplines. Student gender distribution was 54% male and 46% female. The ethnicities of undergraduate students in 2018 were reported as 44% White, 41% Asian and Pacific American, 10% Latino/Hispanic American, 1.7% African American, 1.7% Foreign National (student visa), and 1.7% Other.

The WISE Honors Program offers educational and professional science, technology, engineering and mathematics (STEM) opportunities for undergraduate female students at the university by facilitating individual, institutional, and social change. The main goals of the program are to: 1) provide academic excellence; 2) promote professional development; 3) facilitate research opportunities; 4) establish and maintain community outreach; 5) encourage global collaboration; and 6) enact inclusive strategies. The four-year curriculum was designed to promote academics, research, service, and leadership [21]. The WISE Honors Program is competitive and applicants must have demonstrated aptitude and interest in STEM as evidenced by factors such as mathematics and/or science courses in high school, above-average grades, research or other relevant experience, and above-average scores on the quantitative parts of the SAT or ACT examinations, and/or an SAT science or mathematics achievement test.

The core of the WISE Program curriculum emphasizes not only academic excellence in STEM, but service and leadership with a deep and rigorous research and career focus [21]. The majority of WISE students were residents who lived together freshmen year in a designated dormitory, which was designed to promote social acclimation to campus and major. WISE first-year students all took one-credit introductory seminars on university life and STEM career planning; specific science and mathematics coursework varied by major; for example, engineering students began with physics, mathematics, and introductory engineering. During the first year, WISE students joined five or six additional first-year WISE students in a weekly study and discussion group led by an upper-class undergraduate mentor; the mentors were trained and monitored by WISE faculty and staff. First year WISE members attended evening programs specially designed to introduce and advise students to the opportunities in science and engineering both on and off campus. Declared majors of WISE participants are summarized in Figure 1.

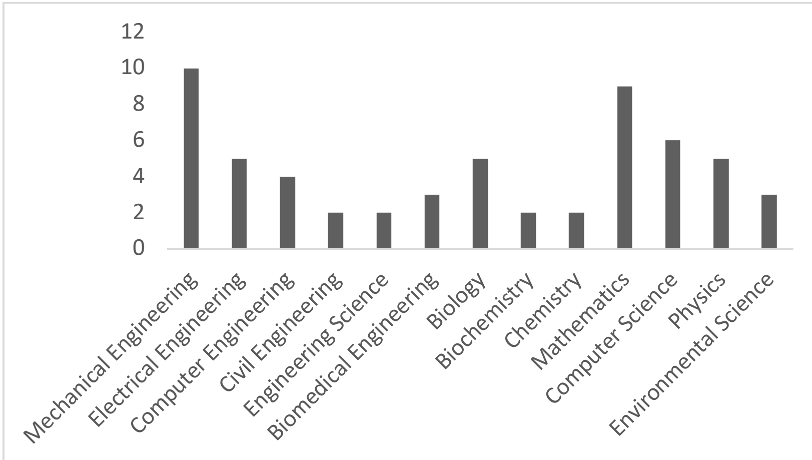

Figure 1. *Breakdown of participant majors in the WISE Honors Program.*

Research design. The theoretical model for this study is based on work by Chouinard et al., and Matusovich et al., and is comprised of the perception of support from social agents, competence beliefs, task values, and achievement goals used to explore persistence for women in science and engineering majors [22], [23]. The first category, perception of social support, includes students' perceptions of encouragement provided by the WISE honors program. The second category represents students' competency beliefs in science and engineering. The third category focuses on task values, particularly utility values, or how well tasks relate to current or future goals and attainment values, the perception of how performance on a task reflects on the individual. The fourth category describes mastery and/or performance approach achievement goals, and, lastly, persistence in STEM comprises an achievement outcome. Figure 2 highlights the expected relationships among variables.

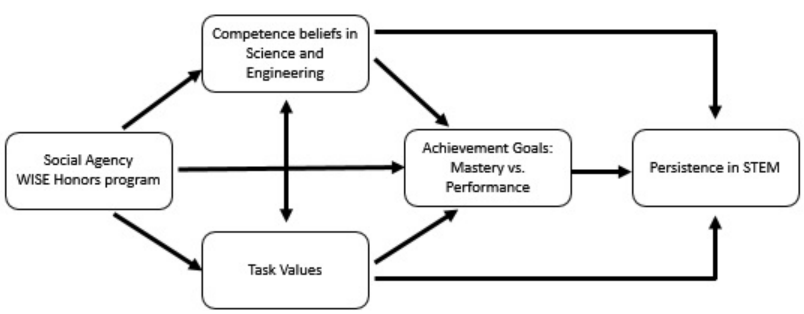

Figure 2. *Direct and indirect relationships between variables to predict persistence in STEM.*

In relation to engineering, Matusovich defined attainment value as a "reason for pursuing (or not pursuing) engineering that is related to the type of person who is an engineer" [23, p.294]. Codes such as "being good at math or science" or "likes to solve problems" would be attainment values, since choosing engineering because of talent in mathematics, science, and problem solving is intertwined with the belief that being an engineer means being proficient in mathematics, science, and problem solving. Selected hobbies or activities that are similar to engineering indicate interest. Utility values may be described as the perceived future importance in the task of engineering, for example, "engineers are well paid" or "I want to get a well paying job after graduation." Cost may be reflected in statements where engineering means sacrificing other interests outside of engineering.

The researchers employed a convergent parallel mixed methods research design [24], with quantitative and qualitative methods for measuring programmatic impacts. Data were collected from a survey conducted at the end of the spring semester 2018 to collect baseline data by evaluating experiences and opinions of the WISE program and students' competency beliefs, task values, and achievement goals. Surveys were completed via Qualtrics and participants were assured their responses would be kept confidential. The perception of support, competency, and task values was measured by a survey adapted from *Assessing Women and Men in Engineering* for $N = 60$ first year female students in science and engineering majors. Responses indicated adequate survey reliability ($\alpha = .77$). Achievement goals were measured qualitatively by responses to open ended questions.

Data analysis. Descriptive statistics (frequencies, means, and standard deviations) were calculated from survey items and Spearman rank order correlations were used to determine the strength and direction of linear relationships between perception of support from social agents, competence beliefs, task values, and achievement goals. Significant correlations were entered into a multiple regression model to test whether feelings of competency were predicted by social constructs, confidence in the major, and preparation by high school coursework. The change in R^2 for all variables of interest was calculated and tested for significance. Linearity was assessed by partial regression plots and a plot of studentized residuals against the predicted values. There was independence of residuals, as indicated by a Durbin-Watson statistic of 2.12. Homoscedasticity was assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. There was no evidence of multicollinearity since tolerance values were greater than 0.1 and VIF values were less than 2.0. The assumption of normality was met as assessed by Q-Q plot.

Qualitative response data were analyzed through coding techniques to elicit key thematic elements; coding was conducted separately by the researchers using response frequencies, and interrater reliability was established through extended discussions to reach 95% agreement. Interpretations were formulated collaboratively and key findings were summarized. Qualitative methods of analysis involved multiple stages of identification of interrelationships among categories and information derived from phenomenology with elements of grounded theory [25]. Grounded theory involves constant comparison of data with emerging categories to maximize similarities and differences between constructs. In the first phase, open ended responses were open coded by noting emerging ideas. These codes included participant perspectives on goals, strengths and weaknesses in their roles as students, satisfaction in their roles as mentees, and strengths and weaknesses of the mentoring program. In the second phase of qualitative data reduction, axial coding was used to make connections between categories that focused on competence beliefs, task values, and achievement goals.

Results: Quantitative Findings

Social constructs. Study participants in the first-year mentoring program reported high levels of social activity with other students both within and outside of their academic majors. The majority of participants, 93% ($n = 52$) reported that they spent leisure time with others in mathematics, science, and/or engineering majors while 82% ($n = 46$) reported spending leisure time with women in STEM majors. Participants were asked to rate how much they agreed or disagreed on a Likert scale of agree, somewhat agree, disagree somewhat, or disagree with the following statements, *When I participate in science, social science, or engineering professional societies or other extracurricular activities, I feel welcome,* 93% agreed/somewhat agreed, 7% disagreed somewhat. Most participants enjoyed working collaboratively, 86% reported agreed/somewhat agreed that they *enjoy working on group work*, 14% disagreed somewhat. Half of the participants (51%) agreed/somewhat agreed they *had many friends study in their discipline*; 50% of respondents reported that they agreed/somewhat agreed that they had *family that were engineers/scientists*.

Competency. All participants attended high school the prior year and they were largely high performing academically in their freshman year of college (*mean GPA* = 3.51, *SD* = 1.12). Measures of competency revealed that 95% reported they were fairly to very confident they would complete their degrees, 97% reported fairly to very confident in completing any science or engineering degree, and 98% reported fairly to very confident that they would complete any degree at this institution. A series of Spearman rank-order correlations was conducted to determine whether there were any relationships between social constructs and competency. A two-tailed test of significance indicated there were significant positive relationships between *spending leisure time with others in science and engineering* and *confidence in completing a CAS/CEAS degree*, $r_s\,(58) = .36, p < .01$; and *spending leisure time with women in science and engineering majors* and *success in major curriculum*, $r_s\,(58) = .24, p < .01$. *Feeling welcome in participation in professional societies* showed a significant positive relationship with *high school coursework prepared me*, $r_s\,(58) = .42, p < .001$, *success in major not giving up extracurricular activities*, $r_s\,(58) = .52, p < .01$; and *success in career related to major*, $r_s\,(58) = .24, p < .01$. A multiple regression analysis was used to predict *achieving success in their major career* from *leisure time spent with women in STEM majors, having many friends studying in their discipline, confidence in completing a science/engineering degree, impact of high school coursework, and not having to give up extracurricular activities*. The multiple regression was significant, $F(5,48) = 9.82, p < .001$, adj. $R^2 = .45$, a large effect size, with significant contributions from social structures, competency in prior course work, and cost of extracurricular activities (Table 1).

Table 1. *Prediction of success in major career for WISE Honors Program Participants.*

Model	**B**	***SE***	***B***	***t***	***p***	***95%CI LB***	***95% CI UB***
Constant	1.27	.90	-	1.40	.17	-.55	3.1
Leisure time spent with other women in STEM	1.31	.59	.23	**2.21***	.03	.19	2.49
I have many friends studying in my discipline	-.005	.18	-.003	-.029	.98	-.36	.35
Confidence in being enrolled in CAS/CEAS major	.004	.19	.002	.019	.99	-.38	.39
High school course work prepared me for my major	.223	.11	.281	**2.11***	.04	.01	.44
I can succeed in my major without having to give up participation in extracurricular activities	.310	.09	.45	**3.31****	.002	.12	.50

$*p < .05$, $**p < .01$

Task values. Regarding the top 3 plans immediately after finishing their degrees, 46% (*n* = 26) reported they would *go on to graduate school,* although 27% (*n* = 15) reported that they were *not sure* what they would do after completing a science or engineering degree; and 14% (*n* = 8) reported that they planned to *work in industry*.

The top two reasons for entering a science or engineering field were attainment value based, with the number one reason as being *good at math or science* (*n* = 35) and second, *like to solve problems* (*n* = 33). The third reason for entering a science or engineering major represented a utility value, *want to get a well paying job after I graduate* (*n* = 28). Additional reasons for entering as a science or engineering major are depicted in Figure 3.

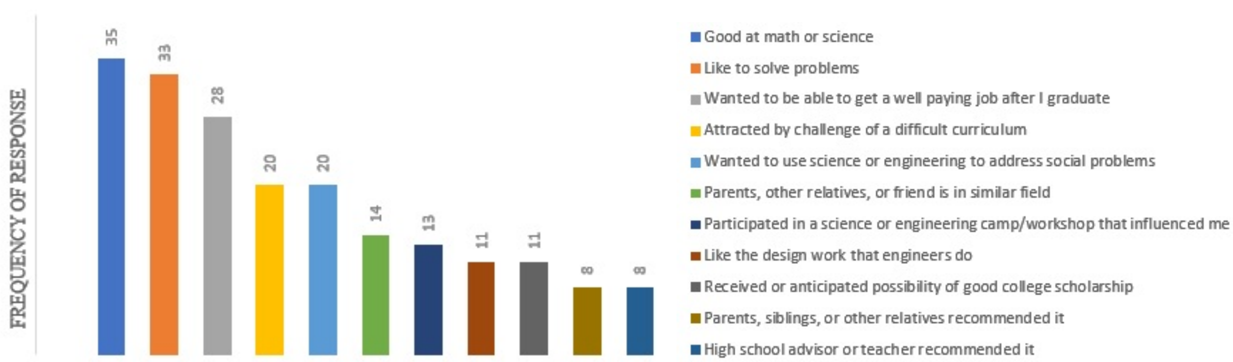

Figure 3. *Participants response to reasons for entering as a science or engineering major.*

Goals for participating in the WISE mentoring program. Students were asked to rank choices indicating their reasons for voluntarily participating in the WISE Honors program. The women reported their number one goal for participating in the program was *to help me do well in my major n* = 49 (82%). The second reason for participating at 63% (n = 38) was *to meet other students in my field*. The third ranked choice at 60% (n = 36) was *help me with career and job* *search skills*. The fourth ranked choice chosen by 32% (n = 19) respondents was *learn about engineering and science*.

Results: Qualitative Findings

Qualitative responses for program goals were first examined for mastery approach vs. performance approach goals. Out of 56 responses, 31 (55%) reported mastery approach goals with only 16 (29%) reporting performance approach goals. Common phrases that were identified as mastery approach goals or performance approach goals are highlighted in Table 2.

Table 2. *Common indicator phrases of mastery orientation vs. performance orientation.*

Mastery Approach	**Performance Approach**
Learn new concepts	Get good
Master new skills	Be good at
Learn as much as possible/gain knowledge	Make work easier
Understand the work	Be smart
Improve on skills	Achieve success
Have new experiences	Be the best at

Mastery goal approach. Many women expressed an interest in developing confidence, gaining knowledge, and developing new skills. A biochemistry major indicated, "I hope to gain an inclusive group of other girls like me, that are supportive. Through participation, I hope to grow to be a more confident individual, prepared," while a chemical engineering major reported:

> I hope to gain a better understanding of computer engineering and the most practical way I can apply what I learn in the real world. I also hope to gain experience in research and to become a better student/learner overall.

Gaining knowledge and skills while making connections with other students was a popular goal for the freshman women. Table 3 contains additional mastery goal approach responses by major.

Table 3. *A sample of the mastery goal approach responses by major.*

Major	Mastery goal approach
Chemical Engineering	Make many friends who are interested in learning about engineering.
Engineering Science	I hope to gain inspiration from the work and values of the women around me and to use it as motivation to push myself to do the best I can.
Biomedical Engineering	I hope to learn new skills.
Computer Engineering	I would like to learn to work collectively with girls of the same mindset as mine, as well as learn to be a leader in the stem field.
Electrical Engineering	I hope to have opportunities that I would not have gotten anywhere else such as internships.
Mechanical Engineering	I hope to gain more information and be able to connect with other girls who are equally motivated in their education.
Mechanical Engineering	I hope to gain experiences and opportunities
Computer Engineering	I hope to gain guidance and beneficial experiences throughout the college years.
Mechanical Engineering	I hope to gain some great friendships and knowledge.
Computer Engineering	Connections and confidence.
Environmental Science	I want to learn from other women in science and build relationships with them.
Computer Science	I hope to have access to a broader range of opportunities to gain experience in my chosen field.
Biology	Academic and social confidence.
Mathematics	I hope to network with other women in the sciences and participate in internships and employment opportunities associated with WISE.
Computer Science	I hope to be able to explore different career paths and subjects to understand where I picture my future self.
Mathematics	I would like to network with other girls that share my interests and learn with them. I also am thrilled about research.
Chemistry	A better understanding of the different professions in the STEM field.
Computer Science	I hope to gain some confidence in pursuing an engineering or science related major. I also hope to meet a lot of new people in WISE.

Performance approach. There were considerably fewer open-ended responses that indicated a performance approach goal despite the survey indicating that the number one goal for participating in the WISE Honors Program was to *help me do well in my major.* Of those who did indicate a performance approach goal, a mechanical engineering major stated that her number one goal for participation was to get a very good job upon degree completion, “I hope to gain a lot of mentoring and guidance for my major so that when I have received my degree I wish to get a very good job.” A civil engineering major expressed a performance approach in a career goal, stating, “I hope to get ahead with being in the honors program, like it will get me a better job.” One biomedical engineering major responded, “I hope it eases how difficult the major will be for me,” while a mathematics major indicated that she hoped “to avoid mistakes.” For those answering open ended items regarding goals and benefits of the WISE Honors Program with a performance approach, the majority indicated that while success in the major was the number one goal, so was the desire to build strong relationships within the program and the greater community. One computer science major concurred with her response:

> I hope to achieve success in my major and achieve my dream of creating video games. I also want to use my interest in game development to impact my community by spreading good messages to the people that take the time to play my games.

An electrical engineering major also expressed her desire for doing well in major courses, but it was with a social support system:

> I hope to build a network of friends and peers who will be able to help me through my major and classes, as well as help them as well. I wish to do well in my courses as well as maintain healthy relationships.

Perception of social support. When asked about satisfaction with participation in WISE, most students responded favorably, highlighting the social support the program provided. The first-year women in the WISE program frequently reported strong relationships with mentors and study groups and the value of social support for advice, guidance, and a sense of belonging. The mentors typically shared the same major with most of the young women in their groups. Table 4 shows the nature of social support responses when participants were asked to elaborate upon their goals for participating in the WISE Honors peer mentoring program.

Table 4. *Social support responses by major.*

Major	Social Support Responses
Mechanical Engineering	I hope to create a greater network of women who share my interests and goals.
Mechanical Engineering	I want to gain friendship and knowledge.
Engineering Science	Connections with driven students.
Mechanical Engineering	I hope to meet other people who are also in the science field. I also hope to gain many connections through research or internship for the future.
Mechanical Engineering	Make more friends with similar interests.
Mechanical Engineering	I hope to meet more women in WISE and connect with them to help close the gender gap in technology.
Electrical Engineering	Meet people like me and try to be more active.
Engineering Science	Meet new people and learn how to succeed while studying engineering.
Biomedical Engineering	Connect with other women scientists.
Chemistry	Support and help from girls in similar majors.
Computer Science	I hope to make connections with other girls in my field and to break the glass ceiling that exists for girls in STEM.
Physics	I hope to be a part of a group of like-minded women who strive to succeed in similar fields as well as network and develop relationships in the professional world.
Physics	A good support system that can help me with any problems I might encounter.
Mathematics	I hope to meet others who pursue the same interests as me.
Biology	Support, encouragement, and collaboration from my fellow WISE members.
Biochemistry	I hope to gain a fellowship of strong women who support each other.
Physics	Meet and network with women from my background and improve myself from it.
Applied Mathematics	Connection to a community of likeminded students.
Applied Mathematics	Opportunities that I could not have gotten on my own and a support system to encourage me throughout my school years.
Applied Mathematics	I hope to gain connections and useful tools that'll help me in my career.
Mathematics	Valuable life skills, a good education, and some friends.
Biochemistry	I hope to gain an inclusive group of other girls like me, that are supportive. Through participation, I hope to grow to be a more confident individual, prepared.
Physics	friendships, skillsets, experiences, opportunities.

When asked to comment on their satisfaction, as well as strengths and weaknesses of the program, most students reported that WISE provided a helpful support system in a challenging learning environment. The only drawback to the program may have been the time commitment of the formal peer mentoring sessions, however, the social connections made, and benefits of the WISE Honors program seemed to make the mandatory sessions worthwhile for participants. An electrical engineering major indicated:

> My WISE mentor was amazing. She was always there to listen and open about things. She was someone I could talk to and I learned a lot. She looked out for everyone and helped out so much in studies and getting information. I thought the

> mentoring hours were a good length, although some complained about the time commitment. I don't think it has any weaknesses.

With encouragement and support by an upperclass mentor and a peer group within the same major in science and engineering, students established positive social relationships and a sense of increased confidence within a community of likeminded peers. One biochemistry student stated, “I'm really glad I have been a part of WISE this year. Mentoring was one of the best experiences of my freshmen year, and I really enjoyed listening to professionals talk about their careers.” The support, referrals, and information provided by mentors in the small group settings functioned as a learning community and facilitated social adaptation and academic integration contributing to success in the freshman year. A civil engineering major shared the following:

> I enjoyed the mentoring program. It made me feel like I was not alone in the civil engineering program. My group took the same courses and helped each other out often. Also, I was able to participate in a research program over the summer with a WISE connection.

Many participants expressed that the program allowed them to develop relationships with women with similar interests and this helped them cope with academic stressors. A computer engineering major stated, “I love my mentor very much and she was incredibly helpful and necessary in my success as a freshman as well as in my mental sanity through the difficulty of computer engineering.” The peer mentoring and social connections that were made promoted a deeper level of interaction between women in similar majors fostered communication, and increased opportunity for academic growth and intellectual development within a support system.

Discussion and Conclusions

This study supports previous findings where expectancy-value and achievement goal variables independently predicted achievement related outcomes [16, 23] as well as supporting the work done by Wang and DeGol demonstrating that achievement goals may act as the mediator between competency beliefs and persistence behaviors [5]. Ability, as evidenced by the mean GPA of 3.51 in this sample has been previously shown to be associated with persistence in college [26]. With ability accounted for, competency was demonstrated with the vast majority of participants reporting fairly to very confident that they would complete their science and engineering degrees. Competency beliefs were also shown to be statistically significant in the multiple regression where high school course work predicted success in their major. The expectancy component in expectancy value theory corresponded to competency beliefs and self-efficacy. Students in the WISE program reported a high degree of self-efficacy with their expressions of high competence in science or engineering. Values such as interest, enjoyment, and task values such as attainment and utility values, showed the level of importance assigned by program participants to activity engagement.

Attainment values were represented by survey responses where competence, interest in problem solving, and attraction to the challenge of a difficult curriculum ranked in the top four reasons for majoring in science or engineering. Utility values, or how well tasks related to current or future goals, were represented by the third ranked reason for majoring in science or engineering – the desire for a high paying job after graduation. Utility values were also evident in the qualitative responses where women reported gaining opportunities, internships, and networking for future career opportunities were what they hoped to benefit from the WISE Honors program. Social engagement provided by the formal peer mentoring had a positive impact on the freshman women, facilitating a sense of belonging, and connections made with peer mentors drove interest, engagement, and enjoyment in the programs as the freshmen women integrated into their majors.

Results also suggest that students' perceived competence and their value for a task may predict their achievement goal approach. Pintrich argued that expectancy value models focused on individuals' expectations of success and task values but have not examined how these variables might be related to achievement goals [18]. High expectations for success were viewed by Elliot and Dweck as the facilitator for adoption of a mastery and performance approach [15]. Our results support previous findings that students with a sense of competence at a task are more likely to use a mastery and performance approach without avoidance behavior, and those with high perceived competence appear to be more resilient to failure in comparison to individuals low on perceived competence on a task who may react more strongly to failure [20]. Reflected in the number one and number three reasons for participating in the WISE program, *help me do well in my major* and *help me with career and job search skills*, our participants expressed a performance approach that did not involve a fear of making mistakes or was concentrated on outperforming others. To the contrary, performance indicators centered around achieving success by building strong relationships and connections with other students and mentors. With the majority of qualitative responses regarding goals for the program falling under a mastery approach coupled with the valuable perception of social support within the program, students were focused on learning new skills, seeking challenges, and had hopes for making connections with those interested in learning about science and engineering, supporting our model for increased persistence in STEM (Figure 2). Indeed, the social structures of spending leisure time with other students in STEM, and not having to give up participation in extracurricular activities, significantly predicted belief in achieving success in a career related to their majors. A limitation of this study is the exploratory nature of the single post-program survey design, future work will include pre- and post-testing of an incoming WISE Honors Program cohort to further explore the direct and indirect relationships between variables to predict persistence in STEM. Preliminary findings indicate that competency beliefs, task values, and achievement goals may be positive predictors of persistence in STEM for first year female students in science and engineering.

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Bibliography

[1] R. A. Simon, M. W. Aulls, H. Dedic and K. Hubbard, “Exploring student persistence in STEM programs: A motivational model,” *Canadian Journal of Education*, vol. 38, 1-26, 2015.

[2] J. S. Eccles, A. Wigfield, "Motivational beliefs, values, and goals," *Annual Review of Psychology*, vol. 53, pp. 109-132, 2002.

[3] J. S. Eccles, "Subjective task value and the Eccles et al. model of achievement-related choices," in *Handbook of Competence and Motivation*. New York, NY, US: Guilford Publications, 2005, pp. 105-121.

[4] J. S. Eccles, "Who am I and what am I going to do with my life? Personal and collective identities as motivators of action," *Educational Psychologist*, vol. 44, pp. 78-89, 2009.

[5] M. T. Wang and J. Degol, “Motivational pathways to STEM career choices: Using expectancy-value perspective to understand individual and gender differences in STEM fields. *Developmental Review*, vol. 33, 2013.

[6] A. M. Kelly, "Social cognitive perspective of gender disparities in undergraduate physics," *Physical Review Physics Education Research,* vol. 12, 020116, 2016.

[7] C. Ames, “Achievement goals and the classroom motivational climate,” In D. H. Schunk & J. L. Meece (Eds.), *Student Perceptions in the Classroom.* Hillsdale, NJ, US: Lawrence Erlbaum Associates, Inc., 1992, pp. 327-348.

[8] A. Bandura, "Perceived self-efficacy in cognitive development and functioning," *Educational Psychologist*, vol. 28, pp. 117-148, 1993.

[9] R. M. Ryan and E. L. Deci, “Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being,” *American Psychologist*, vol. 55, pp. 68-78, 2000.

[10] C. S. Dweck and E. L. Leggett, "A social-cognitive approach to motivation and personality," *Psychological Review*, vol. 95, pp. 256-273, 1988.

[11] J. M. Furner and A. Gonzalez-DeHass, “How do students' mastery and performance goals relate to math anxiety?” *Eurasia Journal of Mathematics, Science & Technology Education*, vol. 7, pp. 227-242, 2011.

[12] M. L. Maehr, “Goal theory is not dead- not yet, Anyway: A reflection on the special issue,” *Educational Psychology Review*, vol. 13, pp. 177-185, 2001.

[13] A. J. Elliot and T. M. Thrash, “Achievement goals and the hierarchical model of achievement motivation,” *Educational Psychology Review*, vol. 13, pp. 139-156, 2001.

[14] A. J. Elliot and H. A. McGregor, “A 2 x 2 achievement goal framework,” *Journal of Personality and Social Psychology*, vol. 80, pp. 501-519, 2001.

[15] E. S. Elliott and C. S. Dweck, "Goals: An approach to motivation and achievement," *Journal of Personality and Social Psychology,* vol. 54, pp. 5-12, 1988.

[16] P. A. O'Keefe, A. Ben-Eliyahu, and L. Linnenbrink-Garcia, “Shaping achievement goal orientations in a mastery-structured environment and concomitant changes in related contingencies of self-worth,” *Motivation and Emotion*, vol. 37, pp. 50-64, 2013.

[17] C. S. Dweck, "Motivational processes affecting learning," *American Psychologist*, vol. 41, pp. 1040-1048, 1986.

[18] P. R. Pintrich, “A motivational science perspective on the role of student motivation in learning and teaching contexts,” *Journal of Educational Psychology*, vol. 95, pp. 667-686, 2003.

[19] A. J. Elliot and J. M. Harackiewicz, “Avoidance achievement goals and intrinsic motivation: A mediational analysis,” *Journal of Personality and Social Psychology*, vol. 70, pp. 461-475, 1996.
[20] L. E. Baranik, L. J., Stanley, B. H. Bynum, and C. E. Lance, “Examining the construct validity of mastery-avoidance achievement goals: A meta-analysis,” *Human Performance*, vol. 23, pp. 265-282, 2010.
[21] A. M. Kelly, D. Aveni, M. F. Bugallo, “Women in Science and Engineering: A Framework for an Honors Curriculum,” in *Proceedings of the 2018 ASEE Annual Conference,* Salt Lake City, UT, June 2018, 23365.
[22] R. Chouinard, T. Karsenti, and N. Roy, “Relations among competence beliefs, utility value, achievement goals, and effort in mathematics,” *British Journal of Educational Psychology*, vol. 77, pp. 501-517, 2007.
[23] H. M. Matusovich, R. A. Streveler, and R. L. Miller, “Why do students choose engineering? A qualitative, longitudinal investigation of students' motivational values,” *Journal of Engineering Education*, vol. 99, pp. 289-303, 2010.
[24] J. W. Creswell and J. D. Creswell, *Research Design: Qualitative, Quantitiative, and Mixed Methods Approaches (5th ed.)*. Los Angeles, CA: Sage, 2018.
[25] A. Strauss and J. Corbin, *Basics of Qualitative Research Techniques*. Thousand Oaks, CA: Sage, 1998.
[26] T. Vincent, "Dropout from higher education: A theoretical synthesis of recent research," *Review of Educational Research,* vol. 45, pp. 89-125, 1975.