UNDERSTANDING THE MOTIVATION OF FEMALE PH.D. STUDENTS TO ENROLL AND PERSIST IN STEM-RELATED FIELDS

by

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Title: Understanding the Motivation of Female Ph.D. Students to Enroll and Persist in STEM-Related Fields

The study used a sequential explanatory mixed methods research design to examine the motivational and behavioral factors that underlie underrepresented female Ph.D. students' decisions to enroll and persist in STEM-related fields. Quantitative survey data were collected using the Motivated Student Learning Questionnaire (MSLQ) along with five social and emotional well-being open-ended questions. Qualitative data were collected through focus groups. The self-regulated learning framework was used to examine the motivation/affect, behavior, and contextual factors used to inform the investigation. Findings from the study suggest specific supports that universities could implement to increase the enrollment and persistence of female Ph.D. students in STEM-related fields.

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DEDICATION

I would like to dedicate this to the Witherspoon legacy. I would also like to dedicate this to those who are not here to witness this moment: Stanley Witherspoon (my father) and Dr. Tina Harris (my mentor); whom each had value in helping me proceed with this dream. To my father, who I promised I would pursue a doctorate after receiving my MBA and to Dr. Tina Harris, who inspired me in pursuing this degree through her completion and mentorship. You two always encouraged and stressed the importance of education. I love you both and know you are sharing this wonderful moment with me from Heaven.

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CHAPTER I

INTRODUCTION

Once a leader in STEM[1] education, the United States now ranks 20th worldwide in the number of people per capita obtaining a Natural Science or Engineering degree by the age of 24 (Congressional Research Service Report for Congress, 2008). In 2014, the National Science Foundation reported that the overall proportion of STEM post-secondary degrees earned has remained at 17% over time in the United States, although some STEM fields (e.g., Computer Science, Biology) have seen an increase (Kuenzi, 2008). Improving recruitment and retention in STEM fields is a critical challenge facing the nation because of the increased reliance on scientific advancement and innovation. STEM fields remain vitally important for maintaining national security, economic competitiveness, and quality of life (Ong et al., 2008). Former U.S. President Barack Obama noted the importance of regaining U.S. global leadership in STEM:

> The key to meeting these challenges – to improving our health and well-being, to harnessing clean energy, to protecting our security, and succeeding in the global economy – will be reaffirming and strengthening America's role as the world's engine of scientific discovery and technological innovation. And that leadership tomorrow depends on how we educate our students' today, especially in those fields that hold the promise of producing future innovations and innovators. And that's why education in math and science is so important (Obama, 2009. p.2).

One critical component to strengthening scientific advancement in the U.S. is building a robust workforce in the STEM fields (National Academies, 2010a, 2010b; Ong et al., 2011). As evidenced by the U.S. ranking noted above, the U.S education system that has failed to adequately prepare students interested in and capable of pursuing STEM fields, contributing to the stagnation of STEM graduates (National Academies Press, 2010). One area particularly ripe for growth is enhancing the diversity of STEM graduates by supporting the enrolment and persistence of female graduate students in STEM-related fields. In 2012, women were slightly overrepresented among science and engineering degree recipients at the bachelor's level, but underrepresented at the masters, and doctoral levels, earning just over 50% at the bachelor's level, 46% at the master's level, and 41% at the doctoral level (NSF, 2012, p. 1). Increasing female students' persistence in STEM-related field presents one way for the U.S. is to regain its prominence in STEM; understanding the factors associated with female Ph.D. students' enrollment and persistence in STEM-related programs can help attain that goal.

Project Overview

This study explored motivational and behavioral factors around the enrollment and persistence of female Ph.D. students in STEM-related fields at the University of Oregon. The dissertation is presented in five chapters. Chapter Two reviews the literature on female Ph.D. students in STEM-related fields, followed by an overview of self-regulated learning, the theoretical framework that is used as the lens for the study. Chapter Three presents the research methods, including data collection and analysis as well as a discussion of the study's validity constraints. Chapter Four presents the study findings, both quantitative and qualitative, organized by research question. Lastly, Chapter Five provides a discussion of the results, implications for policy and practice, and identifies the limitations of the study and areas for future research that could continue to enhance the field.

CHAPTER II

LITERATURE REVIEW

Overview

In this chapter, I begin with a description of the literature search process. I started by accessing the University of Oregon's online library portal. I used the education and sociology research guides, which led me to the following databases: ProQuest Educational Journals, SAGE Complete, Academic Search Premier, Academic OneFile, SpringerLink, ProQuest Social Science Journals, PSYCNet, and ERIC. Although these academic databases provided the majority of the articles included in my literature review, I also used Google Scholar and ancestral reference searches to make sure I had completed an exhaustive search of my topic.

Search Procedures

My literature pool included eight peer-reviewed articles (Ong, Wright, Espinosa, Orfield, 2011; Espinosa, 2011; Smith, Davidson, 1992; Mcgee, 2016; De Welde, Laursen, 2011; Williams, Phillips, Hall, 2016; Frehill, Ivie, 2013; Chambers, Zurbriggen, Syed, Goyza, Bearman, 2011) that I used in a previous academic project that were influential in shaping my interests regarding motivation and student learning strategies around women's enrollment and persistence in STEM Ph.D. programs.

To add to those eight studies, I conducted four searches. To ensure that my literature review included research on my population of interest (female Ph.D. students), areas of interest (enrollment and persistence in doctoral programs), and graduate programs of interest (STEM-related fields), I chose specific terms to guide the search process. My first search included the terms (a) graduate women, (b) STEM, and (c) Ph.D.

programs, which produced one article that met my inclusion criteria. The second search included the terms (a) female students, (b) STEM, and (c) Ph.D. programs, which produced 48 results. I was able to filter these articles down to two through reviewing the titles and abstracts. Most of the articles examined doctoral programs, but with further investigation in reading the abstracts, I found that the studies included female students were did not examine the specific experiences of female students, the topic of interest for my study.

After the first two searches, I determined that using the acronym STEM limited the results specific to my study because STEM can be listed and represented in different ways, for example, by listing the specific degree areas or spelling out the full acronym. Plus, the keyword STEM brought up scientific studies of diseases as well as medical studies. Therefore, I discarded the term STEM for the rest of the searches. My third search included the key words (a) women and (b) Ph.D. programs, which produced four relevant studies: one was a dissertation, and three were theoretical studies. I used the reference list from the dissertation to conduct an ancestral search, resulting in an additional three empirical articles aligned with my topic of interest.

This multi-step search process resulted in 15 peer-reviewed articles that examined female students in STEM-related Ph.D. programs.

Results

I systematically reviewed and synthesized the literature pool by dividing the review into six major categories: (a) types of research design, (b) subjects, (c) field of study, (d) setting, (d) measures, and (f) success factors.

Types of Research Design. Table 1 summarizes the research designs for the 15 studies included in this literature review. First, I identified the studies as either quantitative, qualitative, or mixed methods. Then, I classified the research design as longitudinal or cross-sectional. A longitudinal study is designed to permit observations over an extended period of time to gauge change; in contrast, cross-sectional studies are designed to collect observations at a single point in time (Babbie, 2013).

As shown in Table 1, a range of study designs were used in the prior research in my topic. The five longitudinal, quantitative studies focused on a variety of topics related to the persistence factors, attitudes, and experiences of female students in STEM-related Ph.D. programs. For example, Wright, Espinosa, and Orfield (2011) used a longitudinal database of STEM education and careers of undergraduates and graduate students to obtain insight into factors that influenced retention, persistence, and achievement of female students of color in STEM fields. Espinosa (2011) also used a longitudinal database, data from UCLA’s Higher Education Research Institute Cooperative Institutional Research Program that examined the relationship between persistence and precollege characteristics, college experience, and institutional setting.. Other longitudinal studies focused on specific populations: Maton et al. (2016) used data from an intervention program for high-achieving underrepresented students in STEM Ph.D. programs, Strayhorn et al. (2013) used survey data of students from historically Black colleges, and Hanson (2013) used the National Survey of College Graduates database that examined STEM degree completion and occupations within the Latino population.

The three other longitudinal qualitative studies all examined the experiences of women of color in STEM-related fields over time. Ceglie (2012) explored religion as one of the support factors for a group of Latina and African American woman majoring in Science both at the undergraduate and graduate level. Fries-Britt, Mwangi, and Peralta (2014) examined the perceptions and educational experiences of international, foreign-born students of color majoring in physics during undergraduate and graduate programs. Blevins Green (2015) explored the role of mentorship for students of color in Ph.D. STEM programs.

The three cross-sectional quantitative studies examined the levels of faculty support and professional development of African American graduate students (Smith and Davidson II, 1992), the role of efficacy and science identity of students of color in graduate programs (Chemers, Zurbriggen, Syed, Goza, and Bearman, 2011), and the recruitment efforts to enroll and increase persistence of students of color in STEM doctoral programs (Shadding, Whittington, Wallace, Wandu, and Wilson, 2016). The two cross-sectional qualitative studies examined the informal and formal barriers for women in Ph.D. STEM programs (McGee 2016) and the motivational factors that influence African American students to attain a Ph.D. in engineering or computer science programs (De Welde and Laursen, 2011). The two cross-sectional mixed methods studies analyzed the experiences of underrepresented students in STEM doctoral programs and the ways in which gender bias is intertwined with race in the STEM fields (Mwenda, 2010; Williams, Phillips, and Hall, 2016).

Table 1

Studies

	Study			Design	
Citation	Longitudinal	Cross-Sectional	Qualitative	Quantitative	Mixed
1	X			X	
2	X			X	
3		X			X
4	X				X
5		X	X		
6	X			X	
7	X			X	
8		X		X	
9	X			X	
10		X	X		
11	X		X		
12		X	X		
13		X			X
14		X		X	
15		X		X	
Total	7	8	4	8	3

Participants. In addition to the range of research designs described above, the studies included in this literature review included a range of sample sizes from 16 to 172,250 participants (see Table 2). Participants also included a variety of racial backgrounds. Based on my search terms, the studies included all focused on influences and/or barriers for female doctoral students' enrollment and persistence in STEM Ph.D.

programs; some conducted a comparison of males and females and some examined racial differences.

There were four studies (Blevins, 2015; Espinonsa, 2011; Ceglie 2012; Williams, Phillips, Hall 2016) that collected data on the opinions of women either through surveys, interviews or focus groups, and then compared the responses of white women with women of color. For example, Espinosa's (2011) longitudinal study compared the pathway experiences for White women and women of color to assess the association between precollege characteristics, college experiences, and institutional setting..

Three of the 15 articles focused solely on students of color as their subjects, comparing findings across subgroups of women (Ong, Wright, Espinosa, and Orfield, 2011; Mwenda, 2016; De Welde and Laursen, 2011). For example, Ong, Wright, Espinosa, and Orfield (2011) included undergraduate and graduate women of color in STEM fields in their longitudinal study, looking for differences among African American, Native American, Hispanic, and Asian American female students. In contrast, Mwenda (2016) included participants from these same subgroups but examined similarities around funding concerns and the importance of faculty and peer relationships for students of color in STEM Ph.D. programs.

Four studies (Blevins Green, 2015; Hanson 2004; Fries-Britt, Mwagi, Peralta, 2014; Shaddington, Whittington, Wallace, Wandu, and Wilson, 2016) focused on comparing findings from two race/ethnicity groups, either African American and Hispanic or White and Hispanic. For example, Blevins Green (2015) used surveys which collected information regarding persistence factors in STEM Ph.D. programs and then

Table 2
Subjects

Citation	N	Race/ Ethnicity						Gender	
		W**	A.A**	Hisp.**	AI/AN**	Asian	Interntl**	Male	Female
1	-*		X	X	X	X	X	X	X
2	1,250	X	X	X	X	X			X
3	307		X	X	X	X		X	X
4	26		X	X					X
5	44		X					X	X
6	109	X	X	X		X		X	X
7	16,610		X					X	X
8	298		X					X	X
9	172,250	X	X	X				X	X
10	16		X	X	X	X			X
11	-*		X	X			X	X	X
12	28	X	X	X	X	X		X	X
13	617	X	X	X	X	X			X
14	-*	X	X	X	X	X		X	X
15	185		X	X		X		X	X
Total		6	15	12	7	9	2	11	15

interviewed participants to further discuss the importance of the role of mentorship in these programs.

Note. (-) = Unknown number of participants; W= White, A.A. = African American, Hisp. = Hispanic, AI/NA = American Indian/Native American, Int = International

Fields of Study. Table 3 shows the field of study examined within each of the 15 articles in my research pool. Two of the articles grouped fields into a single STEM category while the other thirteen identified specific STEM fields by individual subject. For example, McGee (2016) included three individual STEM areas - engineering, computer science, and technology - in his/her study of African American students' motivation for persisting and obtaining a Ph.D. Two of the studies (X and Y) compared the experiences of students in STEM and non-STEM fields.

Table 3
Fields of Study

Citation	Life Sci.	Phy Sci.	Gen Sci.	Math	Comp Sci. & Tech	Eng	STEM	Psy	Tech	Non-STEM
1	X	X	X	X	X	X	X		X	
2			X	X		X	X		X	
3			X	X		X			X	
4			X	X		X		X		
5					X	X				
6						X	X			
7										X
8							X			X
9			X	X		X	X		X	
10			X	X		X			X	
11							X			
12			X	X		X			X	
13			X	X		X			X	
14			X							
15			X	X		X			X	
Total	1	1	10	9	2	11	6	1	8	2

Note. Life Sci= life science, Phy Sci = physical science, Gen Sci = general science, Comp Sci &Tech = computer science and technology, Eng = engineering, STEM =Science, Technology, Engineering and Math NSF definition used, Psy = psychology, Tech = technology, Non- STEM = all fields mentioned that were not considered a STEM-related field of study.

Setting. Table 4 shows the different types of settings in which the 15 studies included in my research pool were conducted, which. I have classified as one of the following: (a) Predominantly White Institution (PWI), (b) Hispanic Serving Institution (HSI), (c) Historically Black Colleges or Universities (HBCU), or (d) Tribal College or University (TCU). The variety of settings gives an array of different student perspectives around what influences or provides barriers around enrollment, persistence, retention and recruitment of female students in STEM Ph.D. programs as different types of institutions have different demographics, research status, and academic specialties.

Five studies (Shadding, Whittington, Wallace, Wandu, and Wilson, 2016; Wright, Espinosa and Orfield, 2011; Blevins, 2015; De Welde and Laursen, 2011; Williams, Phillips, and Hall, 2016) assess the barriers and influences female students of color face at PWI's. Thirteen studies compare female students' experiences at PWIs and minority-serving institutions, such as Shadding et al.'s (2016) study of recruitment efforts of minority undergraduates to STEM graduate programs at minority serving institutions, predominantly white institutions, and other four year colleges.

Table 4
Setting

	Institution Type				
Citation	PWI*	HSI*	HBCU*	TCU*	4-year college
1					X
2					X
3	X				X
4					X
5	X		X		X
6					X
7			X		X
8			X		
9					X
10	X				X
11					
12					X
13					X
14					X
15	X	X	X	X	X
Total	4	1	4	1	13

Note. PWI = Predominantly White Institutions, HIS = Hispanic Serving Institutions, HBCU = Historically Black Colleges and Universities, TCU = Tribal Colleges and Universities

Measures. Table 5 summarizes the type of data collection measures used in the studies included in this literature pool. The four qualitative studies (Mcgee, 2016; Ceglie, 2012; Fries-Britt, Mwagi, and Peralta, 2014; De Welde and Laursen, 2011) all used newly developed interview protocols, and two of the four studies (Ceglie, 2012; Fries-Britt, Mwagi, and Peralta, 2014) conducted focus groups. Ceglie (2012) used a two-phase study design, starting with interviews that explored the types of experiences and factors that offered support during participants' pursuit of a degree in a STEM field, and then conducted focus groups around the themes that emerged from the individual interviews to gain perspectives from a broader group. De Welde and Laursen (2011) conducted in-depth interviews to elucidate the gendered and influential aspects of the barriers and strategies used to navigate through the STEM fields as female Ph.D. students.

Of the eight quantitative studies, four (Wright, Espinosa and Orfield, 2011; Espinosa, 2011; Strayhorn, Williams, Tillman-Kelly and Suddeth, 2013; Hanson, 2013) administered existing survey instruments and four (Maton et.al., 2016; Smith and Davidson, 1992; Chemers, et.al., 2011; Shaddington, Whittington, Wallace, Wandu, and Wilson, 2016) used newly developed survey instruments. For example, Strayhorn, Williams, Tillman-Kelly, and Suddeth (2013) used data collected from the Baccalaureate and Beyond Longitudinal Study that identified factors that graduates of Historically Black Colleges and Universities considered when choosing graduate programs and Maton et al. (2016) obtained data through an existing survey administered through the University of Maryland's Meyerhoff Scholars Program to compare students of color and their peers who were in the program with students who were not in the program. In contrast, Chemers, Zurbriggen, Syed, Goza, and Bearman (2011) created a web-based survey that they administered to Chicano and Native American undergraduate, graduate and post-doctoral students at the University of California, Santa Cruz to understand the ways in which science support factors such as self-efficacy and identity as a scientist contribute to science experiences and commitment to science careers.

The three mixed methods studies (Mwenda, 2016; Blevins, 2015; Williams, Phillips, Hall, 2016) in this literature review all developed new survey and interview protocols. For example, Mwenda, (2010) developed and administered surveys to understand the influences of financial support and Blevins Green (2015) surveyed students about the role of faculty and peer mentorship. Both authors used their survey results to develop interview protocols and conduct interviews to further investigate the experiences female doctoral students face in STEM-related program.

Table 5
Measures

Citation	Literature Review	Newly Developed Survey	Existing Survey	Existing Interview	Newly Developed Interview	Focus Group
1	X		X	X		
2	X		X			
3		X			X	
4		X			X	
5					X	
6		X				
7	X		X			
8		X				
9	X		X			
10					X	X
11					X	X
12					X	
13		X				
14		X				
15		X				
Total	4	7	4	1	6	2

Success Factors. The studies included in my literature review examined the perceived success factors and/or barriers experienced by female graduate students in STEM-related programs. The factors included a range of individual characteristics (self-efficacy, science identity, and religion), supports (peer, faculty, family, and financial), and institutional factors (outreach, climate, mentorship, graduate training and networking, higher education systems, and undergraduate transitions and pipelines) that may play a role in female students' enrollment and persistence in STEM-related field.

Individual characteristics. The three individual factors identified in the literature pool were self-efficacy, science identity, and religion.

*Self-efficacy***.** Eight out of the fifteen articles identified self-efficacy as an important success factor. Self-efficacy has been related to persistence, tenacity, and achievement in a range of social science settings (Chemers et al., 2011; Bandura, 1986; Zimmerman, 1989). Among women in STEM fields, greater perceived science identity compatibility predicts greater sense of belonging, or the feeling that one fits in or is accepted in an environment (Rosenthal et al., 2013; London et al. 2011; Rosenthal et al. 2011a). According to (Maton et al.'s (2016) Meyohoff Science program study, students in Ph.D. STEM-related programs are more likely to persist if they develop greater levels of research self-efficacy during their program, which support a sense of belonging. McGee's (2016) study found that, "it was critical for Black engineering students to be able to see themselves as teachers to help cope with rigorous demands of the STEM degree completion" (p. 181). Fries-Britt, Mwagi, and Peralta (2014) found that self-efficacy was especially important for foreign- born graduate students of color in helping overcome stereotypes and discrimination in American college classrooms and combat acculturative stress feelings of isolation

Science identity. Science identity was mentioned as a success factor in five out of the fifteen articles. This success factor is similar to self-efficacy, but based solely on students seeing themselves as scientists. Ong et al. (2011) argues that the ways in which women construct science identity as STEM majors is centered on academic self-concept, self-efficacy and overall confidence in their academic abilities. Maton et al. (2016) found that minority students who benefited from the Meyerhoff program elements developed greater levels of science identity and self-efficacy, two critical variables linked to academic success in STEM (p. 8). Further, Chemers et al.'s (2011) study found that science self-efficacy and identity as a scientist were more important predictors of commitment to a career in science than institutional support activities.

Religion. Religion was mentioned in only one of the fifteen articles. Religion was hypothesized as a form of social or cultural capital (Ceglie, 2012). In this study religion was perceived as a challenge if science did not align with students' beliefs, but discovered ways to advance learning by exploring the alternative ways of understanding cultural factors that influence core beliefs such as familial beliefs, customs or religious views. Furthermore an examination of more inclusive strategies such as culturally responsive teaching learning environments was found as a positive contributor to underrepresented students academic achievement (Ceglie, 2012). The study found that religion as an academic support has a positive influence on African American and Hispanic students and was later hypothesized as serving as a source of social capital for these students (Ceglie, 2012). Although religion was mentioned in only one article it seems to have some influence on academic achievement and serves a positive resource to support underrepresented students in academic settings (Ceglie, 2012).

Supports. The research pool identified four types of influence and support that help and hinder female students' enrollment and persistence in STEM-related fields: peer, faculty, family, and financial.

Peer support. Peer support was mentioned in four out of the fifteen articles. Peer supports discussed in the research pool included formal opportunities for support (e.g., study groups) as well as more informal aspects such as relationships with students in their program. Espinosa's (2011) study found that academic peer relationships were an especially important success factor for women of color in STEM-related programs, who often find it challenging to form meaningful relationships in courses where the majority of the students are White/and or male. Similarly, Mwenda (2016) reported that "five out of the eight minority interviewees and one of the five minority students who responded to the survey's open-ended question reported that they perceived social support from their peers to have a positive impact around their academic success" (p. 91).

Faculty influence and supports. Eight out of the fifteen articles included in the literature review identified the importance of faculty influence and support. Although mentorship (discussed below) and faculty influence and supports seem similar, McGee's (2016) study found that faculty influence and support, "plays a major role in determining Black students' choice to matriculate in a Ph.D. engineering program…. Without assistance from others in navigating the pathways to the Ph.D., these students acknowledged they most likely would have embarked on a trajectory that did not include obtaining a Ph.D. in engineering" (p. 184). Similarly, Mwenda's (2010) study found that students whose relationship evolved and changed over time with their faculty mentor gave them confidence as an emerging researcher and scholar, therefore increasing their control of learning beliefs towards their career in a STEM-related field.

Family influence and support. Four of the fifteen studies found that family influence and support was a success factor in female doctoral students' enrollment and persistence in STEM-related fields. McGee's (2016) study found that in addition to peer support, Black students reported the importance of family and extended kin networks – in their enrollment and persistence in STEM doctoral programs. Similarly, Ceglie's (2012) study found that underrepresented students reported family support as an important factor in their academic pursuits in STEM-related fields.

Financial supports. Five of the fifteen articles found that funding is an important success factor. Ong et al.'s (2011) study found that costs associated with graduate school are an especially important factor in retaining women of color in graduate STEM programs. Similarly, Strayhorn et al.'s (2013) study found that female minority graduate students were more concerned with their access to financial aid when choosing a graduate school compared to men.

Institutional factors. There were six institutional factors identified in the research: outreach, climate, mentorship, graduate training and networking, higher education systems, and undergraduate transitions and pipelines.

Outreach. Outreach was mentioned in five of the fifteen articles. Interestingly, these studies noted the importance of both providing and receiving outreach. For example, Ong et al.'s (2011) study found women of color in graduate STEM programs were active, or planned on being active, in reaching out to other women to draw them into STEM. Similarly, McGee's (2016) study found that female Black students in engineering doctoral programs sought to provide outreach in academia for future Black scholars at the undergraduate and graduate level.

Climate. Seven of the fifteen articles mentioned the role of climate for female

Ph.D. students in STEM-related fields. STEM social and cultural climate is a leading challenge to the persistence of women of color in STEM career trajectories (Ong, Wright, Espinosa, and Orfield, 2011). Climate plays a role in students' campus experiences and outcomes depending on what type of college or university a student attends. For example, (Espinosa, 2011) found that students reported being adversely affected by an institutional culture that values research over teaching if the student prioritizes teaching, arguing that the "loss of talent is tragic in these situations given the barriers that minority women must overcome to enroll in STEM in college, only to potentially be turned away from these fields due to an inhospitable academic climate" (p.234).

Climate was a tangible factor for some minority students in STEM Ph.D. programs at a Predominately White Institution (PWI) who came from an undergraduate program at Historically Black Colleges and Universities (HBCU) (Mwenda, 2016; Strayhorn, et al., 2013). Minority students reported difficulty transitioning to the PWI because of a culture they felt excluded them from study groups by majority students as well as by fellow minority peers from PWIs because the latter perceived minority students from HBCUs to be less qualified academically (Mwenda, 2016). This sense of negative climate was similar for students from HBCUs who transitioned to a PWI for post-BA studies as their undergraduate counterparts at PWIs, who reported a climate of racism, isolation, negative judgment of academic ability, and a lack of support from faculty, staff, and the overall institution (Strayhorn et al., 2013)).

Mentorship. A mentor is defined in the literature pool as an experienced faculty or staff member who provides a variety of guidance to the graduate student such as program guidance, counseling, moral support, and facilitating the realization of an academic pursuit (Smith and Davidson II, 1992). Formal and/or informal mentorship was found in 9 of the 15 studies as a vital factor in female students' success in STEM-related fields (Ong et al., 2011; Burlew & Johnson, 1992; Hall, 1981; Ong, 2002; Sader, 2007). Ong, et al.'s (2011) study found that for female Ph.D. students of color in STEM-related fields, mentors often play important roles in their decisions to attend graduate school, choose a particular doctoral program, and/or continue with or leave the programs. Mwenda's (2010) study found it was important to allow the mentor to mentee relationship to evolve to the point of faculty treating students like junior colleagues because this promoted positive career aspirations in the field of study. Maton et al.'s (2016) study found that "academic advising from staff, peers, and mentors is important to help students make informed, strategic decisions about the number and type of courses to take (and retake) and which possible research opportunities to pursue" (p.8). Smith and Davidson II's (1992) study found that faculty mentorship not only helped female doctoral students persist in doctoral program, but also helped promote success post-graduation.

Mwenda,'s (2010) study found that mentorship is not always a positive factor in students' experiences; rather, students can perceive mentorship as positive or negative depending on the relationship. Positive mentor benefits included facilitating a smooth academic transition from undergraduate to graduate programs, providing career advice and training to doctoral students, recommendations of coursework, and tips on how to navigate the discipline; negative mentor experiences included increased number of years in the program if guidance was not adequate or precise, emotional stress due to perceived negative interactions, and lack of trust in the mentor's advice. Given the many roles mentors play, and the range of possible positive and negative outcomes, Smith and

Davidson II (1992) found that it was in the student's best interest to pursue several mentors rather than relying on a single mentor to fulfill the myriad of mentor roles that facilitate successful degree completion.

Graduate training and networking. Four of the fifteen studies found that graduate training and networking is an important success factor for female graduate students in STEM programs. This factor includes the myriad ways in which faculty or a mentor help support graduate students to develop their professional skills including "work experience in industry, high-quality research training, and the development of formal and informal professional networks" (Ong et al., 2011, p. 195). Smith and Davidson (1992) found that the lack of training through conference presentations or publications reduced entrée into academia, a career objective for all of the students in the sample.

Higher education systems. Five of fifteen articles found that higher education systems are a factor in the enrollment and persistence of female students in STEM-related programs. Higher education systems were described in these five articles as the institutional supports or barriers at the department level or system wide. This factor includes explicit systems such as end-of-course grades and specific institutional priorities highlighted I campus materials (Espinosa, 2011) as well as more implicit systems like the pervasive "Good Ol' Boys" club, "the institutional structures of the academy that women found difficult to navigate …[including] conflicts between traditional timeline of academic careers and women's child bearing years" (De Welde and Laursen, 2011, p. 577). When negative, these explicit and implicit higher education systems can make female students feel unwelcomed, unsupported and invisible, reducing students' motivation to complete their degree (Espinosa, 2011).

In contrast, Strayhorn et al. (2013) found that positive aspects of higher education systems played a role in black female Ph.D. students' decision to enroll and attend their undergraduate alma mater for graduate study because the students had already established important faculty relationships and knew how to navigate that particular institution and program.

Undergraduate transitions and pipelines. Four of the fifteen studies found that undergraduate transitions and pipeline serve as a success factor to enrollment and persistence. For example, Ong et al.'s (2011) study reported the importance of student membership in undergraduate honor societies to prepare students for graduate programs. More explicitly, Hanson's (2004) study found that female students who were exposed to higher level, specialized science courses were more likely to enroll and persist in graduate programs than students who had received much of their science education in general education courses.

Literature Review Conclusions

The thirteen different success factors identified in the articles included in the literature review were all found to play a role in enrollment and persistence in STEM-related programs. However, there are notable limitations to the conclusions that can be drawn from the prior research. None of the 15 articles in my research pool examined all thirteen of the success factors so it is impossible to determine the relative importance of the different success factors. For example, Ong et al.'s (2011) study of undergraduates and graduate women of color in STEM fields identified eight out of the thirteen, while De Welde and Laursen's (2011) study of informal and formal barriers for female Ph.D. students in STEM fields identified seven –mostly different – success factors. The variety of success factors examined do not present patterns or consistent findings across studies; rather, they show the variety of findings on this topic (see Table 6). Also, the variety of research methods employed by the studies reviewed prevents conducting a meta-analysis to determine empirical strength of the different factors; for example the qualitative studies lack the sort data to make that type of judgment.

A further limitation in the prior research is the inability to make judgments about which combination of success factors is critical to female doctoral students' enrollment and persistence in STEM-related fields or how success factors interact; it is unknown, for example, if positive climate and adequate funding would be sufficient for students to persist in the absence of other success factors, or if students with peer supports are likely to persist despite a lack of mentorship. Some of the studies did examine how the lack of one success factor contributed to the need for other factors. For example, the lack of faculty role models for women of color, especially in physical science and engineering, was more of a disadvantage to them than their white counterparts because of the added impact of a negative academic culture and climate that tended to discourage these students from the STEM fields (Ong et al., 2011; Espinosa, 2011). Similarly, De Welse and Laursen (2011) found that barriers of mentorship, higher education systems, and self-efficacy factors compounded when a lack of a critical mass of female faculty and students increased feelings of isolation, a lack of camaraderie, and exclusionary practices. Ultimately, however, much more research is needed to be able to isolate which factors are the most critical, and which factors may interact positive or negatively with other factors. My review of the prior research shows that more is unknown than known about the topic of female Ph.D. students' enrollment and persistence in stem-related fields, making this topic ripe for additional research.

Gaps in the Literature Review

In reviewing the literature pool for my study, I found three gaps in the prior research that helped inform my study design: 1) a paucity of mixed methods studies, 2) the limited number of STEM fields included, and 3) use of focus groups in study procedures. First, twelve of the fifteen studies were either solely quantitative or qualitative, creating a gap in mixed methods research. Further, the majority of the quantitative studies used extant data in their examination of the factors associated with female graduate students' persistence, attitudes, experiences, and retention. My study will collect new data specific to my population of interest, female graduate students in STEM-related programs at the University of Oregon. The fours qualitative studies (see table 1) were by nature limited to small samples, thus preventing generalization to the University of Oregon context. Although qualitative research allows for the participant voices to be heard, in these particular studies the participant voices were limited to particular STEM fields and/or specific racial/ethnic populations of women. My study addresses this gap by including diverse populations of women across multiple fields. My study builds on the few studies that used mixed methods designs (Mwenda, 2016; Blevins-Green, 2015; and Williams, Phillips, and Hall, 2016); these studies both collected and analyzed survey data and then conducted one-on-one student interviews that further examined factors associated with boosting retention and recruitment, providing a model for my own study.

The second gap my study fills is in number of STEM disciplines included. The literature review uncovered that most of the prior research around student enrollment and persistence includes four or fewer STEM-related fields (see Table 3) or more broadly on STEM without identifying which program or programs were included. With this gap in mind, I recruited students from eight STEM-related fields at the University of Oregon to investigate potential differences in female perspectives within and across specific programs (see Chapter Three).

Finally, the literature pool showed some limitations in the use of focus groups. As shown in Table 5, focus groups were only conducted in two of the studies (Ceglie, 2012; Fries-Brit, Mwagi, & Peralta, 2014). Further, one of the two studies that used focus groups included “groups” with as few as two people (Fries-Brit, Mwagi, and Peralta, 2014). The focus groups for my study included 3-7 people each for greater generalizability.

Table 6
Findings: Success Factors

	Individual Characteristics			Supports						Institutional Factors			
Citation	Self-Efficacy	Sci. Id	Religion	Peer Supp.	Fac. Infl. & Supp.	Fam. Infl.& Supp.	Funds	Outreach	Climate	Mentor	Grad Train/ Netwk.	H. E. Syst.	Undergrad transition and pipeline
1					X	X	X	X	X	X	X		X
2				X	X			X		X			
3				X	X		X		X	X			
4					X					X			
5	X	X				X			X	X		X	
6	X	X		X	X		X			X			X
7							X	X	X			X	X
8				X	X					X	X		
9	X	X			X	X			X				X
10	X		X										
11	X					X						X	
12	X	X			X	X			X	X		X	
13	X							X	X		X		
14	X	X				X				X	X		
15							X	X				X	
Total	8	5	1	4	8	7	5	5	7	9	4	5	4

Note. Pos = positive, H.E. Syst = higher education systems, Fac Infl & Sup. = Faculty influence and support, Grad Train/Netwk. = Graduate training/network, Fam Infl & Sup. = Family influence and support, Sci Id = science identity, Rel = religion, Undergrad transition and pipeline = undergraduate transition and pipeline, Peer Sup = peer support

Theoretical Framework: Self-regulated Learning

This study utilized self-regulated learning (SRL) as the conceptual framework to investigate the motivational and behavioral characteristics of female Ph.D. students in STEM-related programs. SRL is a motivation and learning perspective that originated in educational psychology, and has been used to capture multiple aspects of undergraduate college student motivation. In this study I have adapted it to be used with doctoral students. The SRL framework allowed me to consider the influences of various motivational and self-regulatory factors (described below). SRL theory expanded on the Information Processing (IP) approach theory, a foundational model that applied quantitative measures from cognitive and educational psychology to better understand college student learning (Pintrich 2004, Biggs, 1993; Dyne et al., 1994; Entwistle and Waterston, 1988). IP was criticized for being too narrowly defined, and failing to include constructs that measured student motivation (Pintrich, 2004). SRL offers a more nuanced way to examine college student learning and motivation and has an empirical research based around self-regulation and self-regulated learning in different contexts (Pintrich, 2004).

Self-regulated learning is defined as “a process by which learners transform their mental abilities into academic abilities” (Zimmerman, 2002 p .65). Zusho (2017) contended that the extensive research on SRL suggested that students who engage in self-regulated learning by monitoring their progress towards learning goals and adjust or regulate their thinking, motivation, and study habits to meet those goals are more likely to achieve academic success than those who do not (Dent and Koenka 2016; Pintrich and Zusho 2007; Zimmerman 2008). After searching *Google Scholar* and a general

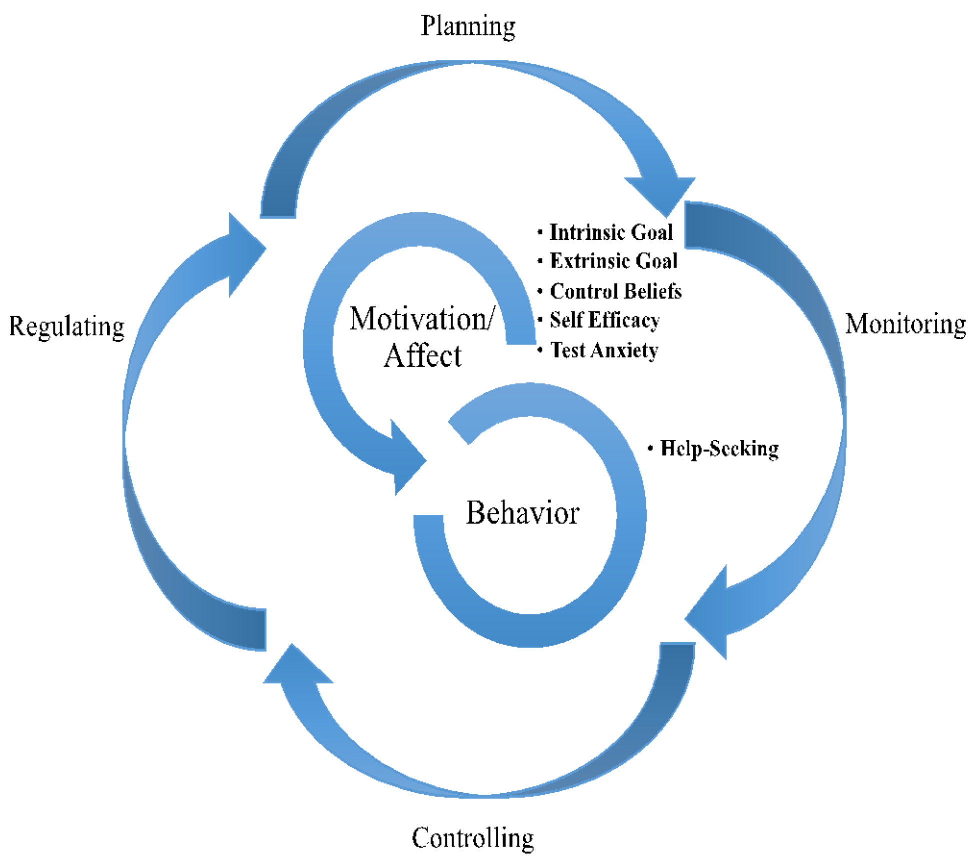
University of Oregon library database, I found a variety of SRL models with many different constructs and categories of student motivation. Zusho (2017) advocated for the use of Pintrich's model, citing Duncan and McKeachie (2005): "When it comes to research within higher education, it can be argued that Pintrich's SRL model…is one of the most prevailing theoretical models, especially considering its connection to the Motivated Strategies for Learning Questionnaire (MSLQ), a popular assessment of college student's cognition and metacognitive strategy use" (p.303). Zusho (2017) notes the extensive empirical research, specifically correlational studies that have used Pintrich's model using the SRL and motivation framework over the past several decades, similar to my non-experimental study (described below).

Figure 1 shows the two regulation factors of SRL (motivation/affect and behavior) that move either sequentially or concurrently through the four general phases of self-regulation: 1) planning, 2) monitoring, 3) controlling, and 4) regulating (Zusho, 2017). The model as shown in Figure 1 should generally be read from top to bottom and clockwise within the circular arrows. The top section illustrates the areas of regulation that describe processes of learners' motivation and affect. The bottom section of the model illustrates the area of regulation that influences learners' behavior.

The following steps are used to unpack SRL: (a) the theory's assumptions will be defined; (b) the two regulation factors will be described; (c) the four phases of the process model will be outlined and; (d) the application of the regulation factors to studying motivational influences of Ph.D. students will be explained.

Figure 1: SRL theoretical framework

model



SRL Theory's Assumptions

Pintrich's (2004) self-regulated learning (SRL) model derives its constructs from an "analysis and application of psychological models of cognition, motivation, and behavior" (p. 388) and includes the following four assumptions:

(a) Active constructivist assumption: learners are active participants, and construct their own meanings, goals, and strategies from external/internal environments (Pintrich, 2004, p. 387).

(b) Potential for control assumption: learners can monitor, control, and regulate aspects of their own cognition, motivation, and behavior as well as some features of their environment (Pintrich, 2004, p. 387).

(c) Goal criterion or standard assumption: learners can set standards and goals to strive for learning, monitor their progress towards those goals, and adapt and regulate cognition, motivation and behavior to reach their goals (Pintrich, 2004, p. 387).

(d) Mediators between personal and contextual characteristics and actual achievement or performance assumption: learners are not bound by individual culture, demographic, and personality characteristics, or contextual characteristics of classroom environment; individual self-regulation of cognition, motivation and behavior play a role in performance (Pintrich, 2004, p. 388).

These assumptions are the foundation of the self-regulated learning framework and how it is viewed and established.

Definition of Regulation Factors

Regulation of Motivation/Affect. According to SRL theory, learners can regulate motivation or affect, also called volitional control (Pintrich, 2004): the power of choosing or determining. The regulation of motivation and affect includes attempts to regulate motivational beliefs: goal orientation, self-efficacy, perceptions of task difficulty, and personal interest in the task. Intrinsic and extrinsic goal setting encompass two areas of this regulation factor to help increase student motivation. For example, “extrinsic goal setting of making good grades for the term is an intentional positive promise contingent on completing an academic task to increase motivation” (Pintrich, 2004, p. 395). Another factor within motivation/affect is self-efficacy. “Students can increase self-efficacy by using positive self-talk (i.e. I know I can complete this program)” (Pintrich, 2004, p. 395). Positive self-talk can enhance students’ perception about their ability to perform a task, which is known to increase motivation and persistence levels (Pintrich, 2004, p. 395).

Motivational beliefs are not the only regulation factor in regards to attempts to control; affect and emotions are used as various coping strategies to help with negative aspects such as fear and anxiety. This motivational/affect area of regulation refers to test anxiety. Pintrich (1991) states, “test anxiety is negatively related to expectancies as well as academic performance” (p.18). Test anxiety can affect a student’s motivation to do well on the test if he or she already feels likely to fail. Test anxiety is known to have two components: a worry/cognitive component and an emotionality component. “The worry component refers to negative thoughts that disrupt performance, while the emotionality component refers to affective and physiological arousal aspects of anxiety” (Pintrich, 1991, p.18). Although test anxiety can affect motivation, training in the use of effective learning strategies and test taking skills could reduce levels of anxiety.

Regulation of Behavior. Regulation of behavior involves individual attempts to control their own overt behaviors in the self-regulating framework. Intentional planning and modeling of these specific activities may be part of a student’s behavior regulation: effort control, help seeking, and time and effort planning or management within academic domains. “It appears that good students and good self-regulators know when, why, and from whom to seek help” (Karabenick and Sharma, 1994; Newman, 1998; Ryan and Pintrich, 1997; Pintrich, 2004). Pintrich (2004) suggests that the inclusion of help seeking as a behavioral factor reflects the importance of the social aspects of learning. Another help seeking aspect is how to seek support from others such as peers and instructors in their environment. Pintrich (1991) suggests there is “a large body of research that indicates that peer help, peer tutoring, and individual teacher assistance facilitates student achievement” (p. 29).

Self-Regulated Learning Phases

As illustrated in Figure 1, SRL theory has four phases (planning, monitoring, controlling, and regulating) that present themselves throughout the two regulation factors (motivation/affect and behavior). The circular arrows represent the four phases that each regulation factor proceeds through. Although the phases are generally sequential, an individual can move through the phases concurrently during particular activities, both knowingly and unknowingly. For example, with the construct of test anxiety, a student could plan to reduce their test anxiety by studying for the test, and may also monitor and control their test anxiety during an exam.

The first phase, planning, is critical to task perception and activation as well as goal setting. In the second and third phases, monitoring and controlling, the self-regulated learner monitors their attention, understanding, motivation/affect, behavior, and effort and engages in strategies to remain on task if found wandering off task. The final phase is the regulating phase. This occurs when the task has been completed, and involves various cognitive judgments and/or affective reactions to outcomes (Pintrich, 2004). During this phase, a student evaluates their outcomes to identify strengths, weaknesses and areas of improvements toward the completion of the endeavor to see where they may plan, monitor, or control the task better the next time.

In the following sections, the way the four phases occur with the two regulation factors is described.

Motivation/Affect. This area focuses on the motivation and beliefs students feel during their coursework or program. For example, planning and monitoring of intrinsic and extrinsic goals is used to help maintain learners' motivation. Control and regulation are essential to student learning strategies because ultimately the students are looking to manage, and adjust as necessary, their behavior specific to the task (Pintrich, 2004). The planning and monitoring phases of self-regulation for motivation/affect happens when students form personal goals and track their progress towards these goals. Control and regulation occur when students choose to stick to goal markers set and reflect on what was accomplished after the goal has been met (Pintrich, 2004). Self-efficacy and control of learning beliefs would move through the phases accordingly: first the planning and monitoring phase would consist of students making efficacy judgments on how they feel about course material in their program at the beginning of the term. During phase three, controlling, a student would then select or adapt strategies for managing their motivation and affect to increase positive efficacy. In the last phase, regulation, a student would then reflect on whether their efficacy increased or decreased during the term or program.

Behavior. As noted above, help seeking is the behavioral regulation factor I included in my study. The behavior factors not included were time and study environment, effort regulation, and peer learning because these factors were less relevant for doctoral students. As measured by the MSLQ instrument, which was originally crafted for undergraduate students, these factors were not relevant for doctoral students because of the basic nature of the questions. The technical manual recommends using modules as appropriate rather than making significant adjustments to the skills assessed. Therefore help seeking was chosen as a factor for this study because the questions about students' help-seeking behavior were applicable to doctoral students. The planning phase for help seeking happens when students identify a professor and/or peer to seek help from. The monitoring phase occurs when the student recognizes during the term the need to increase help seeking from a professor/peer because current efforts are insufficient to meet learning goals. The control and regulation stages are when a student chooses to review the progress made throughout the term and adjust help-seeking accordingly.

Application of SRL Framework to Studying Motivational Influences of Ph.D. Students

Although SRL has mostly been used in studies of college students' motivation and behaviors (Pintrich, 2000), it can also be used to help identify motivational/behavior factors for female Ph.D. students of color in STEM-related programs. Pintrich used the SRL framework to create the Motivated Strategies for Learning Questionnaire (MSLQ). According to the MSLQ manual, "the scales are designed to be modular and can be used to fit the needs of the researcher" (Pintrich, 2000). While some of the scales are overly simplistic for the doctoral student context, many of the strategies college students use to plan, monitor, control and regulate their motivation/affect, and behavior apply to the Ph.D. context. By applying the SRL theoretical framework to female Ph.D. students' motivation and learning strategies in my study, the model provides preliminary quantitative data about students' experiences that provide the foundation for the constructs examined in the focus groups (see methods section below), which investigate students' enrollment and persistence in STEM-related programs at University of Oregon.

Social and Emotional Wellbeing

In addition to the constructs included in the MSLQ, my survey included additional questions to capture the social and emotional well-being of graduate students in STEM-related fields to help understand how well-being might interact with students' motivation. The topic of students' social and emotional well-being has grown over the last decade, as awareness of mental health problems continue to rise (Renshaw, Eklund, Bolognino, & Adodo, 2016). While the research reviewed about well-being was not conducted with STEM students, I used concepts from this research base to broaden the constructs included in the survey. For example, Rubin, Evans, and Wilkinson's (2016) findings suggested that "social contact with university friends acted as a significant mediator of the relations between subjective social status (SSS) and depression and satisfaction of life" (p. 732). I therefore added a survey question about understanding how well a student felt they were doing in their program, along with gauging if the student felt they were on track to graduate in the seven-year time frame given by the graduate school. I added another question about understanding if a student was experiencing self doubt in their program in light of Chun et al.'s (2016) study of ethnic identity, cultural congruity, acculturation stress in relation to self-efficacy, and sense of belonging that found that opportunities to increase social networks increase students' sense of belonging.

CHAPTER III

METHODS

My dissertation study explored the factors associated with the enrollment and persistence of female Ph.D. students in STEM-related fields at the University of Oregon. I examined how the six SRL factors (intrinsic goal orientation, extrinsic goal orientation, control of learning beliefs, self-efficacy, test anxiety, and help seeking) were associated with the motivation of female Ph.D. students in STEM-related programs to enroll and persist. This study used a sequential explanatory mixed methods design that involved “a two-phase project in which the researcher collected quantitative data in the first phase, analyzed the results, and then used the results to plan (or build onto) the second, qualitative phase” (Creswell, 2014, p. 224). The following research questions were investigated:

1. Is the MSLQ survey instrument a psychometrically sound measure for assessing the motivation and behavior factors associated with female Ph.D. students in STEM-related fields?
2. What factors from the MSLQ survey are associated with race/ethnicity for female Ph.D. students in STEM-related fields?
3. What motivation factors are associated with female Ph.D. students’ decision to enroll and persist in STEM-related programs?

Mixed Methods Research Design

A sequential explanatory mixed methods research design was used to collect, analyze, and combine qualitative and quantitative data to answer my research questions (Creswell, 2002; Creswell & Plano Clark, 2011). The core assumption of this form of inquiry is that “the ‘mixing’ or ‘blending’ of data provides a stronger understanding of the research problem or question than either by itself” (Creswell, 2014, p.215). The research design utilized a multi-phase approach to mixed methods as shown in Figure 2 (Creswell, 2014).

The initial step in my study was to test the validity of the MSLQ survey instrument. Next, the data collection proceeded as follows: (a) quantitative data were collected from the adapted MSLQ survey administered to female Ph.D. students in STEM-related programs at the University of Oregon (UO); (b) these data were then analyzed to examine the psychometric properties of scores on the MSLQ instrument and inform the creation of focus group questions; (c) focus groups were conducted to further explore the factors that influence and motivate female Ph.D. students in STEM-related fields at UO; and (d) the qualitative and quantitative data were then analyzed together to synthesize the study findings (Creswell & Plano Clark 2007). These steps are described in detail in subsequent sections.

Figure 2. Explanatory Sequential Mixed Methods

Setting and School

The University of Oregon (UO) in Eugene, Oregon is part of the Association of American Universities (AAU) system. 22,980 students were enrolled at UO as of Fall 2017. Out of the total student population, 3,629 (15.8%) were graduate students, 3,091 full time and 538 part-time students. UO's Office of Institutional Research (IR) provided the demographics of all graduate students enrolled as of fall 2017: (52.2%) female, (47.8%) male, (66.5%) White, (0.9%) American Indian, (5.0%) Asian, (2.3%) African American, (7.6%) Hispanic, (12.4%) International, (0.3%) Native Hawaiian, (2.8%) other/unknown, and (2.2%) Multi-Ethnic. Table 7 below presents data provided by the Office of Institutional Research on specific colleges that offer graduate degree in STEM-related fields at the UO:.

Table 7

Doctoral students in STEM-related fields at UO

	Field	Number of doctoral students
	Biology	62
	Chemistry	114
	Computer & Information Science	43
	EARD	31
	Human Physiology	29
	Mathematics	63
	Physics	83
	Psychology	87
Total	8	497

Note. EARD = Earth Science Doctorate

Participants

The participants for this study were currently enrolled female Ph.D. students from these eight STEM-related programs at the UO. The entire population of STEM students was asked to complete the modified Motivated Student Learning Questionnaire. Participants were recruited at meetings of graduate STEM-related organizations and via email based on an email list obtained through UO's Office of Institutional Research.

Time Aspect

This cross-sectional study builds on prior research by addressing the three gaps in the prior research described above as a way to better understand the current phenomenon of interest in Oregon (Babbie, 2013). Although there were two phases to the study, the time between the phase I survey and phase II focus groups was minimal. Also, the phase I survey findings were used to inform the phase II focus groups rather than phase II examining change over time as would be done in a longitudinal study. A cross-sectional design was appropriate for this study as no intervention was implemented and pre and post data was not collected.

Data Collection Instruments

There were two data collection instruments used in this study: (a) a web-based survey (see Appendix A) and (b) a semi-structured focus group protocol (see Appendix B), described in the following sections.

MSLQ survey instrument. The Motivated Student Learning Questionnaire (MSLQ) is available for use through the National Center for Research to Improve Postsecondary Teaching and Learning at the University of Michigan. The MSLQ is comprised of 81 questions, but for the purposes of this study, I used 28 MSLQ questions to focus on motivation and to increase the response rate by limiting the time required by study participants to complete the survey. The MSLQ manual attests that discarding questions will not change the validity or accurateness of findings noting, “The fifteen different scales on the MSLQ can be used together or singly” (Pintrich, Smith, Garcia and McKeachie, 1993, p. 3). Further validity information for the survey instrument is described below.

The shortened survey (see Appendix A) had 28 questions with six item categories. Table 8 shows how the survey items address the two regulation factors (motivation/affect and behavior) that form the basis of the research questions for my study.

Table 8
Survey Questions by Item Category and Regulation Factor

Regulation factor	Item Category	Item Number
Motivation/affect	Intrinsic Goals	1, 16, 22, 24
	Extrinsic Goals	7, 11, 30
	Control Beliefs	2, 9, 18, 25
	Self-Efficacy	5, 6, 12, 15, 20, 21, 29, 31
	Test Anxiety	6, 8, 14, 19, 28
Behavior	Help-Seeking	40, 58, 68, 75

Table 9 further disaggregates each item category into two component scales - motivation and learning strategy - from the survey, aligned with SRL theory (see Chapter Two). The motivation scale included three components: value components, expectancy components, and affective components. The learning strategies scale includes resource management components. These two scales and their components are described in the next sections.

Table 9
Survey Questions by Item Category and Component Scales

	Motivation Scales			Learning Strategies Scale
Item Category	Value Components	Expectancy Components	Affective Component	Resource Management Component
Intrinsic goal orientation	1, 16, 22, 24			
Extrinsic goal orientation	7, 11, 30			
Control of learning beliefs		2, 9, 18, 25		
Self-efficacy		5, 6, 12, 15, 20, 21, 29, 31		
Test Anxiety			3, 8, 14, 19, 28	
Help seeking				40, 58, 68, 75

Motivation component scales. The motivation scales included value components, expectancy components, and affective components.

Value components. There are two value components: 1) intrinsic goal orientation and 2) extrinsic goal orientation. Goal orientation refers to the student’s perception of the reasons why he/she is engaging in a learning task (Pintrich, Smith, Garcia, & McKeachie, 1991; 1993). The intrinsic goal orientation items assess the student’s motivation to learn related to concepts of challenge, curiosity and mastery; extrinsic goal orientation items examine motivational aspects of grades, rewards, performance, evaluation, and competition. According to the MSLQ manual, for a student who scores high in extrinsic goal orientation, engaging in the learning is the means to an end, although the main concern of the student revolves around issues unrelated to the actual task (such as grades, rewards, & performance) (Pintrich, Smith, Garcia, & McKeachie, 1991; 1993). The manual suggests that for students scoring high in intrinsic goal orientation towards an academic task, participation is an end to itself (Pintrich, Smith, Garcia, & McKeachie, 1991; 1993).

Expectancy components. Expectancy components contain two item categories: control of learning beliefs and self-efficacy for learning and performance. According to the MSLQ manual Pintrich, Smith, Garcia, & McKeachie, 1991; 1993), control of learning refers to a student's beliefs that their efforts to learn will result in positive outcomes and the belief that outcomes are contingent on one's own effort, in contrast to external factors (i.e., the teacher). For example, if a student feels they can control their academic performance, the student will most likely put forth the effort to strategically plan to meet the desired outcome. Self-efficacy for learning and performance is comprised of two components of expectancy: 1) expectancy for success, the performance expectations related to task performance and 2) self-efficacy, the self-appraisal of one's ability and skills to master a task (Pintrich, Smith, Garcia, & McKeachie, 1991; 1993).

Affective components. The affective component has one item category included in the adapted survey I used in my study, test anxiety. Test anxiety has been found to negatively relate to expectancies as well as academic performance (Pintrich, 2004).

According to the MSLQ manual, test anxiety is thought to have two components: 1) a worry component, the negative thoughts that disrupt performance and 2) an emotionality component, the affective and physiological arousal aspects of anxiety (Pintrich, Smith, Garcia, & McKeachie, 1991; 1993).

Learning strategies scale. The learning strategies scale consists of items related to a resource management component.

The resource management component is made up of help seeking items. Help seeking involves reaching out to obtain help through peers and/or instructor support.

Additional survey sections. In addition to the 28 MSLQ items I selected, my survey instrument included an emotional well-being section and a demographic section.

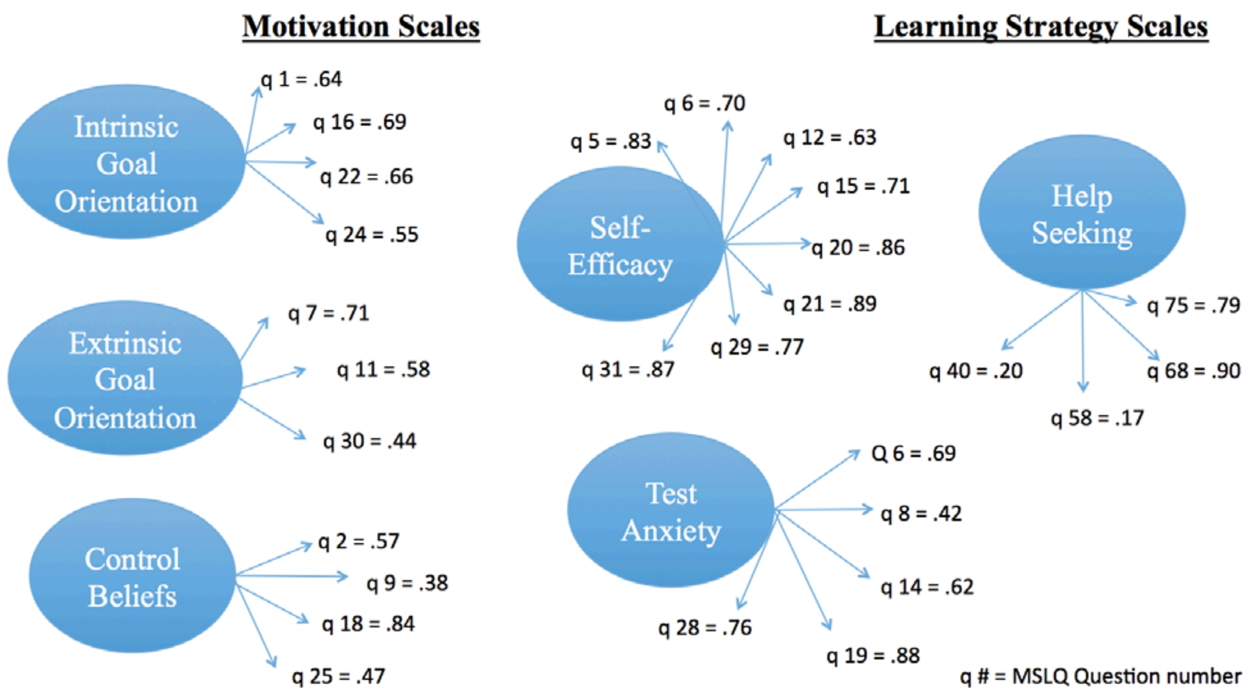
Emotional well-being section. This section was added to the survey in order to gauge students' perception about how they feel they are doing in their program. This section asked students to answer three seven-point Likert scale questions and two yes/no dichotomous scale questions about their emotional well being regarding their status in their program. The purpose of these additional questions was to gain understanding into other factors could explain differences in survey responses by subgroup.

Demographic section. The last section of the survey was the demographic section. This section allowed students to self-report race/ethnicity. The demographic information was used to investigate if there were different motivations and influences for specific populations of students. The final question asked if the student would be willing to participate in a follow-on focus group.

MSLQ validity. According to the MSLQ manual (Pintrich et. al., 1991), the researchers who created and established this quantitative measure tested the factor validity of the scales by running confirmatory factor analyses (Pintrich et. al., 1991, p. 79). Pintrich reports that “parameter estimates for the model specified were generated, and tests for goodness of fit were made to assess how well correlations reproduced given the model specified ‘match up’ with the input set of correlations” (Pintrich et. al., 1991, p. 79). For example, there are four question items - 1, 16, 22, and 24 - that were assumed to be indicators of the intrinsic goal orientation construct; the confirmatory factor analysis tested how closely the factor loadings can be reproduced given the constraints that the items fall onto one specific factor (Pintrich et al., 1991). As shown in Figure 3, the results varied from a high of 0.90 for question 68 on help-seeking to a low of 0.17 on question 58.

Pintrich reports that goodness of fit statistics were reasonable given the broad range of courses and subject domains (Pintrich et al., 1991, p. 79-80). The manual concedes that motivational attitudes and learning strategies may differ for individuals, specific programs, and demands. Pintrich asserts that overall, the model shows a sound structure and one can reasonably claim factor validity for the MSLQ scales, with 13 out of the 29 loadings above 0.70 and 6 of the 29 are above 0.60 (see below in Figure 3) (Pintrich et al., 1991, p. 80, 83).

Figure 3. Motivated Learning Strategy Questionnaire Scales



Focus Group Protocol. The purpose of focus groups was to obtain data in a social context where people can consider their own views in the context of other people's views (Patton, 2012; Maxwell, 2013). A semi-structured focus group protocol (see Appendix B) was developed after the phase one survey was completed and data had been analyzed. The focus group questions were derived from the survey responses to provide further detail by asking focus group participants to talk about specific experiences in the doctoral program and their motivation to enroll and persist in their specific Ph.D. program.

I created open-ended questions based on Patton's (2002) six types of items: (a) experience and behavior questions, (b) opinion and value questions, (c) feeling questions, (d) knowledge questions, (e) sensory questions, (f) background/demographic questions. Once the questions were created, I pilot tested my questions with doctoral student colleagues in UO's College of Education to test the questions for clarity and understanding and to ensure that the questions elicited the information of interest to answer my research questions. According to Maxwell (2013), the key to collecting good qualitative data is creating good questions; therefore piloting the questions is crucial (p. 95). My colleagues who participated in the pilot test recommended that I scale back the number of questions I asked to ensure participants all had a chance to respond in depth to the topics of interest. The pilot study participants also recommended that I ask fewer, broader questions and then ask follow-up probes based on participant responses. Some of my original focus group questions prior to the pilot test became probes. A final suggestion from the pilot test was to add a nominal group technique (NGT) to the focus groups (see data collection procedures section below).The final focus group protocol consisted of three main open-ended questions, with follow-up questions to probe for deeper discussion regarding the experiences of each participant (see Appendix B).

Data Collection Procedures

Data collection for my sequential mixed methods study consisted of two distinct phases. Phase one was the administration of the adapted MSLQ survey. Phase two data collection was conducted through focus groups. The procedures of these phases are described below.

Phase I: Survey. The web-based survey was administered from January 8, 2018 to January 22, 2018. A link to the survey was sent to the population of female Ph.D. students (N = 205) currently enrolled in STEM–related programs at UO. Participants received an email on January 8, 2018 introducing the study and requesting their participation (see Appendix C). An email reminder was sent at the end of the first week (see Appendix E), thanking those that had participated and encouraging others to complete the survey. The survey was closed on January 22, 2018, with an overall response rate of 63 percent (n=128). Respondents had the choice not to answer individual questions on the survey at their discretion; as a result, not all survey submissions had complete responses. There were three participants who did not answer one to three questions on the survey; these submissions were retained in the study. Thirty participants left more than 90% of the questions blank, so their responses were discarded. Ninety-five of the respondents provided complete responses, bringing my final number of participants to 98, a response rate of 46 percent.

Phase II: Focus Groups. Survey participants who volunteered to participate in follow-up focus groups were provided a link at the end of the survey to complete their contact information. The link was used to ensure that their survey data would remain anonymous. Thirty-eight survey respondents volunteered to participate in the focus groups. I sent an email invitation on February 1, 2018 to the 38 survey respondents who had volunteered to participate. Fourteen of the 38 volunteers were willing and available to participate in a focus group. Five focus groups of between two and six students were conducted between February 12, 2018 and February 18, 2018 to obtain data "socially construed within the interaction of the groups" (Maxwell, 2013, p.94). Focus groups sessions lasted about one-hour; I led the discussion and student volunteers typed close-to verbatim notes during the sessions. In addition to the three open-ended questions, I had students complete the nominal group technique (NGT) structured process during the focus groups to further solicit input from a variety of stakeholders about a specific topic (Delbecq, Van de Ven & Gustafson, 1975). I used NGT by asking participants to organize the six SRL factors (intrinsic goal orientation, extrinsic goal orientation, control of learning beliefs, self-efficacy, test anxiety, and help seeking) into a ranked order from the most important to least important factor that encouraged them to enroll and persist in their STEM-related program. According to Delp, Thesen, Motiwalla, & Seshardi (1977), "The silent generation of ideas minimizes the interruptions in each person's thought processes… and discussion only to clarify items helps eliminate misunderstandings, without reducing the group' efficiency" (p. 14). I then asked the participants to hold up a card listing the factor from most to least important one at a time after which there was intervening discussion (Delp, Thesen, Motiwalla, & Seshardi, 1977, p. 14). Finally, I asked participants to vote on the top three factors to determine if the focus group participants could come to a consensus, an NGT process that "clearly highlights areas needing further clarification or discussion…and provides group members a final opportunity to clarify their positions" (Delp, Thesen, Motiwalla, & Seshardi, 1977, p. 15).

Data Analysis and Interpretation

The sequential mixed methods approach required survey data from phase one and interview data from phase two to be analyzed separately initially, as the survey findings informed creation of the focus group questions. The data were combined for final analysis and interpretation to draw conclusions and gain a richer understanding of the results. The separate analysis and interpretation of the survey and interview data will be described first, followed by a description of the combined data analysis and interpretation.

Survey analysis. The quantitative data collected from the survey (n= 95) were analyzed using descriptive and inferential statistics. An exploratory factor analysis of the responses on the MSLQ was first collected. Then, a 2 x 2 MANOVA analysis was conducted with SPSS software to compare underrepresented and non-underrepresented groups and students with more or less self-doubt. The dependent variables were the six SRL factors and the independent variables were race/ethnicity of female Ph.D. students and a two-level categorical representation of the self-doubt question. The statistical significance of each of the predictors and their interaction is reported below.

The open-ended focus group data were coded and categorized through word processing and spreadsheet computer programs (i.e., Word and Excel). I started by coding the data based on the established categories from the MSLQ. There were some additional themes that arose from the focus groups and those codes were captured as well. As Creswell (2014) suggests, “the traditional approach in the social sciences is to allow the codes to emerge during the data analysis” (p. 199). I allowed codes to emerge in this first iteration of qualitative analysis, and then grouped the codes into the six SRL components for the second iteration of data analysis, allowing the most salient topics to emerge. Coding consistency checks were completed by a qualitative researcher at the University of Oregon.

CHAPTER IV

RESULTS

This chapter begins by presenting the descriptive statistics associated with the study sample, female Ph.D. students in STEM-related programs at the University of Oregon (UO). The next section presents the results of the factor analysis that was conducted on responses to items on the adapted MSLQ survey. Results of the MANOVA are presented next. Then data from focus groups are presented to describe the factors participants identified as associated with their motivation to enroll and persist in their doctoral program. Finally, the quantitative data from the factor analysis of the MSLQ survey and the data from the NGT conducted during the focus groups are compared to identify alignment and misalignment between the two sets of data. Finally, the chapter concludes with a summary of the results for each research questions.

Descriptive Statistics of the Sample

Study participants were University of Oregon female Ph.D. students in STEM-related fields. Ninety-eight of 205 students (46%) completed the adapted MSLQ survey and fourteen students participated in focus groups. The focus groups participants were organized by two categories: majors (i.e. chemistry, biology, and anthropology/psychology combined) and a combination of underrepresented racial/ethnicity groups. The purpose of grouping particular majors together was to investigate if there would be commonalities of specific issues for each major. It also created a space of familiarity for students. The combination of anthropology and psychology was due to the number of participants from those particular majors and time slots that the students were available. The purpose of grouping underrepresented female students together was to create a safe space for these women to share their experiences among a group of their peers.

Eighty seven percent of the survey respondents, identified as non-underrepresented female students and thirteen percent identified as non-underrepresented students. Underrepresented students included Hispanic, Native American, and Black, while non-underrepresented students consisted of White and Asian students. The reason for grouping White and Asian students into the non-underrepresented category was because these are the majority populations in STEM fields. Focus Group interviewees were from UO's Anthropology (n = 2), Biology (n = 4), Chemistry (n = 5), and Psychology (3) departments. Four of the focus group participants were from underrepresented groups; ten were from non-underrepresented groups.

RQ1: Validity of the MSLQ

RQ 1 was designed to assess the psychometric properties of the MSLQ. An exploratory factor analysis (EFA) was used to examine the underlying structure of the motivation/affect and behavior items contained in the adapted MSLQ. The survey was constructed to produce scales measuring the constructs of intrinsic goal orientation, extrinsic goal orientation, control of learning beliefs, self-efficacy, test anxiety, and help seeking. Results of the analysis provided general support for the *a priori* organization of items. The analysis was performed using SPSS 25.0 for Windows.

The EFA was estimated using principal axis factoring with a promax oblique rotation. An oblique rotation was used in the estimation as it was expected that the hypothesized dimensions of factors describing the structure would be intercorrelated. In this study, using Kaiser's Rule, the analysis extracted nine factors accounting for

25.555% of the variance of the 28 items. Correlations among the nine factors ranged from .002 to .661. Inspection of the pattern matrix revealed moderate to high loadings for items on their respective factor, but 4 out of the 9 factors were represented by only one or two items. The factor loadings are presented in Table 10 below.

Table 10*
Initial Factor Analysis Results

Items	1	2	3	4	5	6	7	8	9
18	**.962**	-.014	.047	-.238	.087	-.002	-.092	-.054	.054
25	**.941**	.111	.044	-.094	.348	.082	-.084	-.150	.072
4	**.775**	-.142	-.132	-.075	-.219	-.157	.112	.014	-.013
17	**.640**	-.060	.125	-.149	-.483	.097	.087	.278	.004
27	**.542**	-.188	.050	.326	.193	.009	-.256	.165	-.148
10	**.482**	.255	-.176	.085	-.074	-.093	-.149	-.044	.288
23	**.391**	.352	.042	.249	-.104	.060	-.037	.119	-.017
5	-.101	**.998**	.062	-.002	.145	-.133	.026	.133	-.228
13	.018	**.946**	.000	-.034	.168	.072	-.038	.070	.112
3	-.013	**-.460**	.017	.113	.304	-.010	.258	.000	.082
28	.019	.102	**.939**	.009	.002	.014	.041	-.066	.048
29	.092	-.008	**.841**	.055	.086	.075	.068	-.032	-.006
26	-.163	-.051	**.562**	.014	-.220	-.192	-.081	-.060	.095
8	-.103	-.116	-.045	**.824**	.097	.035	-.104	.021	.222
21	-.239	.004	.087	**.798**	-.048	.037	-.118	.024	-.054
2	.168	.223	.016	**.550**	-.075	-.157	.062	-.155	.036
15	.115	.230	-.029	**.350**	-.223	.113	.292	-.129	-.024
7	.097	.147	-.037	-.045	**.918**	.018	.187	-.074	-.143
12	-.004	.095	.080	.025	**.607**	-.039	.295	.120	.112
14	.014	.022	-.060	-.014	.081	**.708**	-.040	-.108	-.004
19	-.010	-.175	.088	.061	.035	**.645**	-.014	.215	.073
1	-.144	.119	.037	-.093	-.273	**.639**	-.055	-.133	.182
20	.079	-.035	-.169	.107	.054	**.510**	.114	-.056	-.226
22	-.089	.010	.081	-.156	.273	.011	**.726**	.032	-.014
16	-.113	-.098	-.079	.017	.206	-.058	**.652**	.030	.254
9	-.217	.219	-.107	-.015	.113	.087	-.017	**.745**	.099
6	.164	.069	-.043	-.017	-.155	-.072	.067	**.742**	.023
24	.127	-.105	.078	.104	-.135	.060	.123	.077	**.618**

Note. See Table 11, to match the item numbers with their questions.

After conducting the initial analysis, a six factor solution was estimated in alignment with the original structure of the MSLQ (refer to factors in Table 11). The six-factor solution accounted for 25.251% of the variance of the 28 items. Item commonalities were generally moderate to high. Items 23 and 26 had low commonalities (h^2 = .113, .198), respectively. These items were excluded in subsequent analyses. Item 18 also showed relatively low commonality (h^2 = .288), but as this item did fit well in the later interpretation, it was retained in the analysis. No other item commonality was below .30. Inspection of the pattern matrix revealed moderate to high loadings for items on their respective factor.

To further examine the factor structure, I ran Velicer's Minimum Average Partial (MAP) test and Parallel tests (O'Connor, 2000). Results of the MAP test suggested retaining four factors. The Parallel tests suggested the retention of five factors. According to O'Connor (2000), although the two tests complement each other in that the MAP tests tends to under-extract and the Parallel test tends to over-extract, optimal decisions must be made by the researcher. As a result, I decided to re-run the six-factor analysis without the two items that had low commonalities in the previous six-factor solution described above. The six-factor solution accounted for 28.085% of the variance of the 26 items. Item commonalities were generally moderate to high. In the reanalysis, the identified factors were labeled as follows: 1) self-efficacy, 2) test anxiety 3) control of learning beliefs, 4) help seeking, 5) intrinsic goal orientation, and 6) extrinsic goal orientation. The first factor, self-efficacy, contained eight items and accounted for 26.594% of the pre-rotation variance. Item loadings on this factor represented aspects of self-perception of skill set. The second factor, test anxiety, contained five items for 9.384% of the pre-rotation variance. Item loadings on this factor represented aspects pertaining to the feelings around test taking. The third factor, control of learning beliefs, contained four items and accounted for 8.036% of the pre-rotation variance. Item loadings on this factor represented aspects of belief towards one's understanding of the course material. The fourth factor, help seeking, contained three items and accounted for 5.175% of the pre-rotation variance. These item loadings represent aspects of seeking help from one's peers or advisor.

The fifth factor, intrinsic goal orientation, contained four items and accounted for 4.150% of the pre-rotation variance. Item loadings for this factor represented aspects of course material that the student finds interesting, satisfying and challenging. The last factor, extrinsic goal orientation, contained two items and accounted for 3.294% of the pre-rotation variance. Item loadings on this factor represented aspects of the importance of good grades. Correlations among the six factors ranged from .006 to .631. The sorted factor loadings of 26 are presented in Table 11 below. The pattern of factor loadings suggested that the six factors were uniquely defined. The generally moderate size of the factor correlations also suggests that facets of these six factors were related, but not so strongly as to suggest that a smaller number of factors were needed. Cronbach's alphas associated with the set of items associated with each factor were modest to strong, ranging from .552 to .879. Together, these results indicate that the adapted MSLQ had reasonable factorial validity.

Table 11

Six Factor Analysis Results

Items	1	2	3	4	5	6
(18) I expect to do well in this program.	**1.00**	.058	-.345	.086	.021	-.056
(25) Considering the difficulty of my program, my ad and my skills, I think will do well in my program.	**.912**	.147	-.181	.084	.158	-.043
(4) I believe I will receive excellent grades in the program.	**.831**	.051	-.052	-.121	-.233	-.108
(17) I'm confident I can do an excellent job on the assignments and tests in the program.	**.727**	-.130	-.064	.117	-.054	.063
(23) I'm certain I can master the skills being taught in my courses	**.559**	-.127	.340	.004	.053	.136
(10) I'm confident I can learn the basic concepts taught in my program.	**.547**	-.114	.084	-.121	-.065	.039
(13) I'm confident I can understand most complex material presented by the instructors in my program.	**.386**	-.137	.162	-.028	.175	.287
(5) I'm certain I can understand the most difficult material presented in the readings for this program.	**.345**	-.202	.234	-.014	-.001	.319
(16) I have an uneasy, upset feeling when I take an exam.	-.053	**.809**	.191	-.096	-.115	.001
(22) I feel my heart beating fast when I take an exam.	.056	**.758**	.081	.015	-.026	.007
(12) When I take tests I think of the consequences of failing.	-.009	**.697**	.003	.093	.034	.227
(7) When I take a test I think about items on other parts of the test I can't answer.	.041	**.621**	-.113	-.025	.173	.121
(3) When I take a test I think I think about how poorly I am doing compared with other students.	-.222	**.599**	.012	.047	-.031	-.075
(21) If I don't understand course material it is because I didn't try hard enough.	-.320	-.062	**.783**	.121	.039	.001
(2) If I study in appropriate ways, then I will be able to learn the material in the course.	.286	.035	**.707**	.028	-.150	-.128
(8) It is my own fault if I don't learn the material in my program.	-.270	.184	**.672**	.033	.055	.012
(15) If I try hard enough, then I will understand the course material.	.344	.082	**.613**	-.069	.069	-.162
(28) When I can't understand the material in my program, I ask another students in the course for help.	.086	.022	.072	**.937**	.040	-.024
(29) I try to identify cohort members in the course whom I can ask for help if necessary.	.112	.126	.079	**.846**	.091	-.025
(26) Even if I have trouble learning the material in my program, I try to do the work on my own, without help from anyone. *(Recoded item)*	-.189	-.212	.034	**.567**	-.211	-.063
(14) In a program like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.	.009	-.009	-.026	-.057	**.767**	-.132
(1) In a program like this, I prefer course material that really challenges me so I can learn new things.	-.050	-.239	.014	.012	**.591**	-.154
(19) The most satisfying thing for me in this program is trying to understand the content as thoroughly as possible.	-.111	.121	-.007	.114	**.554**	.093
(20) When I have the opportunity in this program, I choose course topics that I can learn from even if	.101	.065	.169	-.195	**.472**	-.123

they don't guarantee a good grade.						
(9) The most important thing for me right now is improving my overall GPA, so my main concern in this program is getting good grades.	-.202	.129	-.101	-.079	.026	**.766**
(6) Getting good grades in my program is the most satisfying thing for me right now.	.211	.103	-.038	-.010	-.186	**.546**

The original scale mean, standard deviation, and reliability of each factor are shown in Table 12.

Table 12
Reliability of Six Factors Analysis per Item

Factors	**# of Items**	**Mean**	**Standard Deviation**	**Cronbach's Alpha**
Factor 1: Self Efficacy	7	38.36	6.386	.875
Factor 2: Test Anxiety	5	19.41	7.288	.845
Factor 3: Control Beliefs	4	21.85	3.773	.734
Factor 4: Help Seeking	3	14.94	3.991	.785
Factor 5: Intrinsic Goal Orientation	3	16.14	2.364	.552
Factor 6: Extrinsic Goal Orientation	2	5.43	2.655	.615

RQ2: MSLQ factor differences between race/ethnicity and levels of self-doubt

A multivariate analysis of variance (MANOVA) was performed with self-doubt (high vs. low) and race/ethnicity (Asian/White vs. Other) as the independent variables and the six factor scores as the dependent variables. The analysis was performed using SPSS 25.0 for Windows. Using Wilks' test of multivariate significance, the interaction term and main effects were not related to the weighted multivariate composite $p > .05$. Table 13 presents descriptive statistics on self-doubt and race/ethnicity and the factor scores.

Table 13
Descriptive Statistics on Self-Doubt & Race/Ethnicity

	Self Doubt				**Race/Ethnicity**			
	Yes		***No***		***Other***		***White/Asian***	
Factors	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
1: Self Efficacy	-.064	.966	.989	.347	-.231	1.16	.038	.939
2: Test Anxiety	.039	.960	-.596	.419	.265	.993	-.044	.939
3: Control of Learning Beliefs	-.068	.911	1.04	.529	-.018	1.25	.003	.875
4: Help Seeking	.021	.939	-.328	1.16	-.174	1.05	.029	.936
5: Intrinsic Goal Orientation	-.032	.892	.486	.694	-.078	.997	.013	.873
6: Extrinsic Goal Orientation	.001	.872	-.008	1.16	-.018	.830	.003	.899
n = total students	n = 92		n = 14		n = 14		n = 84	

RQ3: Adapted MSLQ Findings and Focus Group

In this section, I present findings from the focus groups. Qualitative data were collected in five focus groups with a total of 14 participants to further understand the factors associated with the motivation of female Ph.D. students to enroll and persist in a STEM-related field at the University of Oregon. A summary of positive and negative perceptions organized into the six self-regulated learning (SRL) factors are shown in Table 15. The next section presents the differences between underrepresented and non-underrepresented female Ph.D. students and the differences among students in the various STEM-related programs. Finally, data from the Nominal Group Technique (NGT) is summarized.

RQ3: Qualitative Analysis of Motivation Factors. The focus group participants expressed a range of responses to the three open-ended questions, which asked about barriers and supports around motivation to enroll and persist in their Ph.D program. As shown in Table 14, participants' positive and negative perceptions aligned with the six SRL factors presented earlier in the theoretical framework (see Chapter Two), with two notable additional factors emerging from the focus group discussions: sexism and maternal circumstances.

Table 14
Negative and Positive Perceptions from Focus Group Participants

Factor	**Number of Positive Perceptions**	**Number of Negative Perceptions**
Self Efficacy	2	4
Control of Learning Beliefs	6	8
Test Anxiety	4	35
Help Seeking	13	14
Intrinsic Goal Orientation	12	20
Extrinsic Goal Orientation	12	12
Sexism	2	16
Maternal Circumstances	2	9
Total	53	118

Self-efficacy. Self-efficacy focuses on students' perception about their capabilities to produce levels of performance (Pintrich, 2004). Table 15 presents the findings for my survey items about self-efficacy, which included eight questions from the original MSLQ survey. The responses to these items show that self-efficacy characteristics strongly motivate the study participants. For example, 94% of respondents indicated agreement with the statement, "I'm confident I can understand the most basic concepts taught in this program," indicating strong self-efficacy in their programs. Self-efficacy was not as strong an aspect of their program for all of the study participants, with 41% indicating that they disagreed with the statement in question 6 and 22% for question 31. The qualitative responses in the focus groups provide additional insight into the role of self-efficacy in study participants' experiences in their doctoral programs.

Table 15
Self-Efficacy

Item	1	2	3	4	5	6	7
5. I believe I will receive excellent grades in the program.	1	5	7	15	24	30	15
6. I'm certain I can understand the most difficult material presented in the readings of this program.	2	5	15	19	31	16	10
12. I'm confident I can understand the most basic concepts taught in this program.	0	0	1	3	12	21	61
15. I'm confident I can understand the most complex material presented by the instructor in this course.	1	5	5	10	35	30	12
20. I'm confident I can do an excellent job on the assignments and tests in this program.	0	2	4	16	34	27	14
21. I expect to do well in this program.	0	4	4	8	36	21	25
29. I'm certain I can master the skills being taught in this program.	0	1	8	10	30	33	16
31. Considering the difficulty of this course, my advisor, and my skills, I think I will do well in this program.	1	2	3	16	25	29	22

This factor received two positive responses, including one participant who described the self-efficacy she gained by being successful as an undergraduate student and working in research labs. Four participants shared viewpoints of negative self-efficacy. One student reported having self-doubt that made her feel “isolated from my professors and peers,” and another reported, “I don’t have the support system in place that I had during my undergraduate studies,” while another student commented that “I was the only female of color in my program and I doubted myself if I would be understood.” Students reported that these negative feelings of self and self-doubt affected time to matriculation and likelihood of persistence.

Control of learning beliefs. Control of learning beliefs are based on how affect and emotions are used to fight negative beliefs and the belief that efforts to learn will result in positive outcomes (Pintrich, 1998). Table 16 presents the findings for my survey items about control of learning beliefs, which included four questions from the original MSLQ survey. The responses to these items show that control of learning beliefs strongly motivate the study participants. For example, 94% of respondents indicated agreement with the statement, “If I study in appropriate ways, then I will be able to learn the material in this course,” indicating strong control of learning beliefs in their programs. Control of learning beliefs appears “that if I don’t understand course material, it is because I didn’t try hard enough” in their program for all of the study participants, with 21% indicating that they disagreed with the statement in question 25. The qualitative responses in the focus groups provide additional insight into the role of control of learning beliefs in study participants’ experiences in their doctoral programs.

Table 16

Control of Learning Beliefs

Item	1	2	3	4	5	6	7
2. If I study in appropriate ways, then I will be able to learn the material in this course.	0	1	2	1	16	34	44
9. It is my own fault if I don't learn the material in this program.	2	2	7	20	18	30	19
18. If I try hard enough, then I will understand course material.	0	0	4	5	24	41	24
25. If I don't understand the course material, it is because I didn't try hard enough.	3	3	16	21	25	15	15

There were a total of fourteen responses from participants related to control of learning beliefs: six positive and eight negative. Of the six positive responses, one participant reported the importance of finding supports on her own because she "wanted to avoid negative stereotypes of women in science." Another participant stated the importance of focusing on small goals to keep making progress towards her degree, maintaining control of learning beliefs and avoiding falling prey to self-doubt. Four participants reported specific techniques to build their control of learning beliefs: finding writing supports and resources, hiring a statistician for help, finding an outside committee member who understood her research topic to serve as a mentor, and reaching out to a PI to join a specific science lab. These examples highlight ways in which control of learning beliefs can help female Ph.D. students in STEM-related fields disregard their negative thoughts and perceptions to continue to persist.

In contrast, negative control of learning beliefs hindered motivation to persist, such as the feeling expressed by one student and agreed upon by several peers in her focus group: “in STEM undergraduate education programs, professors harp on the notion that in order to be a scientist one must obtain a Ph.D.” This sentiment led students’ to doubt their control of learning and ability to succeed in their chosen field. Control of learning beliefs were hindered by a perception of how unlikely under-represented female students are to succeed in science. As one participant reported, “Hispanic women graduate with the doctorate degrees at less than one percent.” Several students expressed feeling a lack of motivation and struggled to find their identity as a scientist because they lacked the control of learning beliefs to overcome their own negative beliefs about persisting as a graduate student. This was compounded with the added barriers of feelings of inferiority due to a lack of female faculty.

Test anxiety. Test anxiety refers to a worry component that disrupts performance or an additional emotionality component of affect and anxiety (Pintrich, 2004). Table 17 presents the findings for my survey items about test anxiety, which included five questions from the original MSLQ survey. The responses to these items show that test anxiety can affect the motivation of study participants due to the results it seemed to be situational. For example, 60% of respondents indicated disagreement with the statement, “When I take a test I think about how poorly I am going to do compared with other students,” indicating that test anxiety due to comparing counterparts does not effect their motivation in their programs. When students are taking an exam, test anxiety does not appear because item statement “I feel my heart beating fast when I take an exam,” indicated 60% of respondents indicated disagreement. In question 19, 30% of participants indicated having low test anxiety in their program. The qualitative responses in the focus groups provide additional insight into the role of test anxiety in study participants’ experiences in their doctoral programs.

Table 17

Test Anxiety

Item	1	2	3	4	5	6	7
3. When I take a test I think about how poorly I am going to do compared with other students.	14	17	17	12	16	10	12
8. When I take a test I think about items on other parts of the test I can’t answer.	4	21	16	16	20	17	3
14. When I take tests I think of the consequences of failing.	5	21	14	13	22	8	15
19. I have an uneasy, upset feeling when I take an exam.	11	20	13	14	15	13	12
28. I feel my heart beating fast when I take an exam.	14	18	17	11	21	6	11

Test anxiety had a total of thirty-nine responses; four positive responses and thirty-five negative responses. Focus group participants identified a few positive instances of test anxiety that included positive science experiences during their undergraduate programs, which motivated their pursuit towards a doctoral degree in

STEM. One of the participants stated that “undergraduate research helped motivate me,” while another noted that “an undergraduate female professor encouraged me to pursue a graduate school degree.” These participants expressed the importance of positive training and the importance of being part of a STEM pipeline, which helped promote a positive self-image around the skill level to obtain the knowledge to pursue a Ph.D. in a STEM-related field. Another participant noted, “A professor asked me to join a science lab during undergraduate education through outreach,” which further encouraged her beliefs that her “mother instilled about the importance of science education.” Similarly, a participant suggested that her General Chemistry professor was a huge motivator of her becoming a scientist.

Positive pipeline and training encourages students to enroll and persist in a STEM Ph.D. program through undergraduate outreach from faculty and positive higher education systems that allowed these participants to believe in themselves and further encouraged them to pursue a doctorate in a STEM field. For example, one participant reported the positive experience of “having a writing group earlier for support,” noting that she “discovered a writing group outside of my department.”

Despite these positive responses, negative aspects of test anxiety were much more prevalent, with 39 comments indicating negative test anxiety. These perceptions included: a) negative climate in the student’s department or university as a whole, b) hindrances in university systems and structures, c) a lack of graduate supports and training, and d) inadequate science pipeline experiences, all of which affected participants’ motivation to persist in their degree program.

Negative climate. Negative aspects of climate included the specific STEM field environment, campus environment and community environment. A student reported feeling judged and neglected within her department, and not satisfied with her undergraduate training to prepare her for the demands of doctoral work. Climate factors included students' hesitation to turn to faculty to better understand missed answers on exams. Students expressed the feeling that faculty forget that they are students who still need to be taught and are learning what it takes to be a professor, researcher and/or scientist. A participant suggested that the graduate school should reach out to students more to provide needed supports to motivate students to persist in their field.

University systems and structures. Negative university systems and structures reported by focus group participants included a perceived lack of academic supports, training, and transparency. Inadequate academic supports ranged from academic writing feedback, data analysis skills, and scientific training. A participant reported the challenge of "needing writing support to help understand the publication process." Negative faculty interactions were also mentioned as a university system and structure barrier. Two students discussed the feeling that faculty needed training on how to interact fairly with female students. As one participant noted, "If faculty lack ways in supporting students, students must find their own supports." Negative encounters with faculty led to additional barriers reported as students' fear of dropping out before degree completion because of time constraints and inadequate training. Another barrier mentioned was around limited graduate employee (GE) opportunities and student expectations in departments. A participant who served as a GE described the anxiety of being required to teach every quarter, noting "the anxieties it caused in terms of me not being able to solely focus on my research at times because I always have to teach every quarter for funding." Another example of negative university systems and supports that emerged in the focus groups was the lack of experiences presented in their undergraduate programs. A couple of students reported "going to a small teaching and liberal arts college, where the focus was not on research;" the lack of undergraduate research experience caused anxiety because they felt they didn't have the requisite skills once they matriculated that peers from research universities entered the program with. Another participant stated, "My lack of research training made me feel like I wasn't ready for graduate school so I decided to attend a research university to obtain a masters first before entering a Ph.D. program," while another student went out in her field first to work because she didn't feel confident in enrolling in a Ph.D. program.

A further test anxiety factor was related to the anxiety of needing to maintain funding to remain in the program. As one student noted, submitting negative course evaluations can lead to the student being ostracized in their department and the feeling that "funding could even be jeopardized if the faculty member is in charge of the Graduate Employee positions the following year." Other students reported the test anxiety caused by a lack of transparency from faculty and program directors in terms of road maps from matriculation to graduation and career trajectories. As one student reported, "I've been asking previous students in my program about steps/processes towards the dissertation, committee members, experiments, and understanding how to present at a conference and give a poster presentation." The students felt test anxiety related to having to seek out advice on these aspects of doctoral training and guidance, rather than it being systematically provided from faculty within their departments.

Pipeline training. Students also reported negative experiences related to a lack of science pipeline training presenting barriers to their success, including: graduate research training, understanding publishing, and mentoring in poster presentations. One student reported negative experiences of struggling to "find a female faculty member that would be willing to help with a poster presentation or the intricacies of publishing because there are so few and they are always busy and overworked." Students reported that inadequate science pipeline training can hinder students from progressing or affect their motivation if faculty are not willing to recognize the needs of students and provide adequate training.

Although test anxiety did not manifest in terms of test taking experiences, students who participated in the focus groups were mainly beyond their second year and had passed competency tests and completed coursework requirements. A students' surmised, "Had you asked these questions in years one and two of our program we may have felt differently."

Help Seeking. Help seeking pertains to the social aspects of learning, a construct mentioned twenty-seven times in the focus groups. Table 18 presents the findings for my survey items about help seeking, which included four questions from the original MSLQ survey. The responses to these items show that help seeking strongly motivate the study participants. For example, 83% of respondents indicated agreement with the statement, "I try to identify my cohort members in the course whom I can ask for help if necessary," indicating strong help seeking around motivation in their programs. Help seeking appears not to just pertain to "my advisor to clarify" aspect of their program for all of the study participants, with 31% indicating that they disagreed with the statement in question 58.

The qualitative responses in the focus groups provide additional insight into the role of help seeking in study participants' experiences in their doctoral programs.

Table 18
Help-Seeking

Item	1	2	3	4	5	6	7
40. Even if I have trouble learning the material in this program, I try to do the work on my own, without the help from anyone. (Reversed)	8	11	19	13	19	19	9
58. I ask my advisor to clarify concepts I don't understand well.	1	9	4	15	34	25	10
68. When I can't understand the material in this program, I ask another student in my program for help.	1	6	5	6	20	34	26
75. I try to identify my cohort members in the course whom I can ask for help if necessary.	3	3	4	5	19	31	33

Thirteen of the comments from focus group participants related to help-seeking were positive and fourteen were negative, a notable difference from the heavily negative comments aligned with the test anxiety construct. Study participants approached a range of people for help, including mentors, faculty advisors, and family members, and stressed the importance of finding women to fulfill the help-seeking role.

Mentors. Focus group participants reported the lack of female faculty to serve as informal mentors or Principal Investigators in research activities caused a barrier around help seeking because male PI's don't always understand "our issues." Five participants reported "difficulty in touching base with a female PI because there are so few of them and if they are trying to obtain tenure, [it's] almost impossible" to get the needed mentorship from these over-extended women. As one participant noted, "seeking or even finding a PI for support can be difficult." Faculty support for these women seemed to be one of many motivation obstacles to overcome while persisting in a STEM field. Participants noted that the lack of female faculty mentorship, and even presence, reduces participants' drive to persist in the program if they struggle to visualize how they themselves would be successful in such an environment.

Faculty advisors. Help-seeking experiences related to faculty advisors' was mixed, with more negative than positive experiences reported. One student reported, "I switched advisors during my second year because I didn't receive support from my [original] faculty advisor …. Their goals and vision did not align," while another student reported "needing my faculty advisor to be more human when my husband was diagnosed with a severe medical condition, which required my full and immediate attention." Study participants emphasized the important advisor-advisee role in their motivation to persist, and the challenge posed by the absence of this relationship. Further, study participants felt that male-dominated departments often left help-seeking up to the student, as with a student who reported, "I did not have any departmental support in helping me figure out next steps in finding a new advisor because my advisor had to leave due to a severe medical condition." A similar experience was reported by another student who was not assigned a new faculty advisor when he existing advisor went on maternity leave, “I haven’t seen or heard much from my advisor and I wish I had an interim advisor until my advisor returns from maternity leave.”

Family members. Family support was mentioned seven times by study participants as influencing their motivation to pursue a doctorate in a STEM-related field. Study participants noted their families helped them not lose sight of their long-term STEM goals. Focus group participants also mentioned the importance of having strong education and science support within their household. While family help-seeking behaviors were reported as positive, seven participants reported the negative impact of being away from family, as with one participant’s comment that “it was a struggle to move away from my family because they are my main support hub.” In a few cases, participants noted the challenge of not being able to seek help from family members who did not understand what a doctorate involves, as they were the first to pursue a doctoral degree in their family.

Focus group participants also noted the importance of help-seeking from female family members, a source of encouragement and support distinct from the mentors and faculty advisors from whom they sought help. As one study participant reported, “My mother pushed the importance of education,” while another respondent reported, “My mom really influenced me because she had her Ph.D. in science.” In these cases, help-seeking was part of the mother-daughter relationship, external from the student’s academic program but integral to her ability to seek help when needed.

Intrinsic goal orientation. Intrinsic goal orientation refers to behavior that is driven by internal rewards (Pintrich, 2004). Table 19 presents the findings for my survey items about intrinsic goals, which included four questions from the original MSLQ survey. The responses to these items show that intrinsic goals strongly motivate the study participants. For example, 97% of respondents indicated agreement with the statement, "In a program like this, I prefer course material that really challenges me so I can learn new things," indicating strong intrinsic motivation in their programs. Intrinsic motivation appears not to be the "most satisfying" aspect of their program for all of the study participants, with 11% indicating that they disagreed with the statement in question 22. The qualitative responses in the focus groups provide additional insight into the role of intrinsic motivation in study participants' experiences in their doctoral programs.

Table 19
Intrinsic Goal Orientation

Item	1	2	3	4	5	6	7
1. In a program like this, I prefer course material that really challenges me so I can learn new things.	1	0	0	2	24	60	11
16. In a program like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.	0	0	1	4	14	37	42
22. The most satisfying thing for me in this program is trying to understand the content as thoroughly as possible.	0	1	10	22	31	22	12

24. When I have the opportunity in this program, I choose course topics that I can learn from even if they don't guarantee a good grade.	0	1	6	17	24	33	17

The comments made by focus group participants related to intrinsic goal orientation included love of knowledge and career aspirations. There were a total of forty-six comments related to intrinsic goal orientation: twenty-six were positive and twenty were negative.

Love of knowledge. Study participants described their quest for knowledge as playing a key role in their decision to enroll and persist in a STEM-related doctoral program. Several students made comments having to do with "a love for science and animals" and being attracted by the vision of "seeing myself as becoming a scientist." As one participant said, she was driven to enroll in a Ph.D. because of the "unanswered questions during and after my undergraduate program," while another participant similarly noted that she was "interested in specific questions that were asked in my field, and without pursuing graduate school my questions would not be answered."

Career aspirations. Career aspirations were also mentioned by study participants as feeding into their intrinsic goal orientation. One participant noted, "I always wanted to teach future teachers how to teach," which motivated her to get a Ph.D., while another student reported, "I knew I wanted to get a Ph.D. since I was in middle school to pursue my career field." Specific career aspirations pushed these female students to matriculate and persist in their current programs. One student reported that her motivation to pursue a Ph.D. was driven by a desire not to end up in a “typical scientific repetitive job.” In contrast, diminished career aspirations reduced intrinsic motivation to persist. Three participants reported having entered their Ph.D. program wanting be a professor, but no longer feeling that drive. Another participant discussed a transition from intrinsic to extrinsic motivation, noting, “Instead of doing academic research, I [now plan to] leave academia to do research for a corporation for more diversity and funding.”

Extrinsic goal orientation. Extrinsic goal orientation focuses on obtaining rewards and the positive evaluation of others (Pintrich, 2004). Table 20 presents the findings for my survey items about extrinsic goals, which included three questions from the original MSLQ survey. The responses to these items show that extrinsic goals do not motivate the study participants in regards to grades and grade point average. For example, 86% of respondents indicated disagreement with the statement, “Getting good grades in my program is the most satisfying thing for me right now,” indicating poor extrinsic motivation in their programs. Extrinsic motivation appears not to be the “most important” aspect of their program for all of the study participants, with 86% indicating that they disagreed with the statement in question 11. Although extrinsic goals based on grades do not appear to be the “most important,” participants indicated in question 30 the importance of doing well for their family, friends, employers, and others, with 68% indicating they agreed. The qualitative responses in the focus groups provide additional insight into the role of extrinsic motivation in study participants’ experiences in their doctoral programs.

Table 20

Extrinsic Goal Orientation

Item	1	2	3	4	5	6	7
7. Getting good grades in my program is the most satisfying thing for me right now.	20	17	23	16	12	10	0
11. The most important thing right now is improving my overall grade point average, so my main concern in this class is getting a good grade.	42	21	16	7	9	1	2
30. I want to do well in this class because it is important to show my ability to my family, friends, employer, or others.	1	5	7	17	23	18	27

Extrinsic goal orientation examples were mentioned twenty four times in the focus groups: twelve were positive and twelve were negative. The comments associated with extrinsic goal orientation overwhelmingly centered on funding and included: program funding, travel expenses, financial living adjustments, and childcare expenses. Two respondents identified positive financial motivation to pursue their Ph.D. noting that in order to "have specific job prospect opportunities and advance in the field monetarily, a Ph.D. would be required." Another student reported that one motivation to pursue and persist in her program was due to "full funding for their program and research" while one student admitted leaving her career to pursue a doctorate meant "I knowingly agreed to being poor for 5-6 years."

Four respondents reported funding challenges within their department. A student reported having to take on "teaching assignments every quarter in certain departments," and another noted that limited "funding resources can delay research and/or graduation."

Lastly, a participant noted “that there is a funding discrepancy between being in a hard or soft science field.” As these examples show, funding was both an enabler and a barrier to female students’ motivation to pursue and/or persist in a STEM-related doctoral program.

Sexism. Sexism was a construct not included in the MSLQ but was a topic that emerged through the open-ended focus group questions. This construct had a total of eighteen responses, two positive and sixteen negative. While generational differences were noted by participants in one focus group, with the comment that older women in their departments “accepted sexism and stated that they should just accept sexism because their generation had to and overcame it,” while “newly hired younger female faculty have made it clear that no sexist views should be tolerated,” other participants noted that sexism across generations persisted, reporting “male peers say sexist comments and create a sexist environment, which segregates female students.”

Maternal Circumstances. Although maternal circumstances were not one of the six MSLQ factors, focus group participants noted a variety of ways maternal circumstances interacted with their decision to enroll in and persist in their doctoral program. These included “child care costs and services” and “time away from my kids and balancing school and family.” Maternal circumstances were mentioned eight times in the focus groups, clustered around three participants who either became mothers before or during their program. Participants described a mix of positive and negative experiences related to their status as mothers. As one participant noted, “part of my decision to choose the University of Oregon was based on the child care center provided on campus for my kids to attend.” In another case, the financial burden of motherhood made living on GE wages difficult: one participant reported paying over “twenty thousand dollars in daycare costs, which is more than I make in a year." Each of these mothers discussed the role of their spouse in their decision to enroll and persist in a doctoral program. As one participant said, "I had to make sure my spouse would be able to find employment" before enrolling at UO since it required the family to relocate. Lastly a student reported, "worrying about whether or not I would even be able to interview for my program because it required me to fly during my last trimester and [I wondered] would the UO admit a pregnant student?" Other students discussed the feeling that they should postpone motherhood until post-graduation, which one student described as "putting my life on hold for my Ph.D."

The focus groups findings provide insight into a range of positive and negative aspects of the six MSLQ factors (intrinsic goal orientation, extrinsic goal orientation, control of learning beliefs, self-efficacy, test anxiety, and help seeking) and two additional factors (sexism and maternal circumstances). In addition to these salient themes, there were some notable differences between the experiences reported by underrepresented and non-underrepresented participants as well as among participants' majors, described in the following sections.

Differences between Underrepresented and Non-Underrepresented Students. There were differences between the experiences reported by study participants from races/ethnicities underrepresented in STEM-related fields – African American, Latina, and Native American –compared to the experiences of non-underrepresented – white and Asian - female STEM Ph.D. students. Underrepresented students made explicit mention of family and peer support as part of a community of color as well as specifically seeking support from faculty of color. As one student reported, "I waited to commit to my program because I was the only student of color in my program or cohort." Another student reported, "I was worried I wouldn't be accepted culturally." The five underrepresented students all expressed the challenge of adjusting to the predominantly white study body at UO and in the state. As one participant put it, "I had to adjust to the culture shock when moving here from out of state along with feeling a loss of community." A further concern noted by one student was "the limited contact of faculty of color let alone a female of color within my department." A coping mechanism shared by these students went beyond the family support noted by the participants as a whole. For underrepresented students, help-seeking included seeking "empathetic cultural understandings."

Non-underrepresented students were more apt to discuss issues of sexism and maternal circumstances. These students discussed the feelings of sexism in their department; as one student reported, she experienced "reaching out to male faculty to discuss sexism issues and being turned down as if it is the norm in that particular environment and to get used to it." Another student noted, "Because the female PIs are limited, I have reached out to a male PI's wife and faculty members in other fields to try and help express my feelings" and seek advice "on how to move forward in such an environment." Non-underrepresented women were the only participants in the focus groups who had taken on motherhood before or during their program.

Differences among Students' Majors. Students in the focus groups were from UO's Anthropology, Biology, Chemistry, and Psychology departments. There were not many departmental differences, but students from each department focused on particular aspects of their experiences more than students in other departments. For example, anthropology students referred to funding as being a distinct issue compared to students from other departments. These students expressed the stressors of not having sufficient funding requiring them to “seek other resources such as grants to pursue their research interests.” Three of the four biology students had children and planned on pursuing their degree because being a mother was accepted and not frowned upon while participating in the biology department. Students in the chemistry department discussed the importance of female faculty who taught their undergraduate degrees, but these students all reported experiencing sexism in their department more frequently than students in other departments. The chemistry students further noted “wanting more female faculty relationships and mentorship from female faculty even if that meant receiving cross discipline support.” Lastly, the three psychology department students all discussed wanting clear program requirements and milestones leading up to the dissertation. As one said, “I feel lost after coursework, not knowing how many experiments or publications are required and how to obtain a dissertation committee.”

Summary of Key Results

The main findings of the study are summarized below by research question.

RQ1: Validity of the MSLQ. An exploratory factor analysis was conducted in phase I to test the validity of the MSLQ. After running an exploratory factor analysis and computing the MAP and Parallel tests, I concluded that it was reasonable to retain six factors for my study. The phase II nominal group technique conducted during the focus groups asked the participants to rank the importance of the six MSLQ factors. The rankings further supported keeping the six factors identified in the factor analysis (see Table 21).

Table 21

Nominal Group Technique Focus Group Rankings

MSLQ Factor Analysis Ranking	Ranking					
	1	**2**	**3**	**4**	**5**	**6**
1: Self Efficacy					X	
2: Test Anxiety						X
3: Control Beliefs			X			
4: Help Seeking				X		
5:Intrinsic Goal Orientation	X					
6: Extrinsic Goal Orientation		X				

RQ2: Underrepresented female Ph.D. student differences. The mixed methods design used in my study allowed me to first determine if there were motivational/behavioral differences between non-underrepresented and underrepresented female Ph.D. students through my survey instrument and then in the focus groups. The small number of underrepresented female Ph.D. students on the University of Oregon made it difficult to identify any statistically significant differences between ethnic groups when running multivariate analysis. This led me to group focus group participants to enable comparisons between race/ethnicity. The focus groups did find differences between underrepresented and non-underrepresented students: the former were explicit about seeking support from faculty or color, while the latter focused on sexism and maternal circumstances.

RQ3: Factor associations. Study participants reported a mix of positive and negative experiences related to each of the six MSLQ factors. Test anxiety received the highest proportion of negative comments, and included experiences around participants' perception of university systems and supports, climate, and pipeline training. Positive perceptions related to help seeking were based on having positive female role models, as well as showing grit and perseverance in seeking help on their own. Lastly, the focus group findings captured participant differences across the programs included in this study. The focus groups exposed two additional factors associated with students' decision to enroll and persist in a Ph.D. program in a STEM-related field that were not part of the SRL theoretical framework or the MSLQ: sexism and maternal circumstances. Since SRL theory and the MSLQ instrument are not program-specific, and more generally used with undergraduate students, it is not surprising that sexism (more prevalent in STEM) and motherhood (more prevalent among older students) were not included.

The next chapter will present the conclusions of the study by research question, present limitations of the study, and discuss future research needed in this field.

CHAPTER V

DISCUSSION

In this chapter, I discuss the results of the quantitative and qualitative findings by research question, and include a discussion of the contextual factors associated with female Ph.D. students' motivation to enroll and persist in STEM-related programs at UO. Following the discussion of the findings, study limitations, implications, and future research directions are presented.

My study aimed to understand the motivation of female Ph.D. students' to enroll and persist in a STEM-related field. As noted earlier, although 51 percent of STEM undergraduate degrees are earned by women, they do not pursue or persist in STEM-related doctoral programs in commensurate numbers with their male counterparts (NSF, 2014). This dissertation study used self-regulated learning (SRL) theory to better understand the motivation/affect and behavior of women who do pursue doctorates in STEM-related fields, examining contextual factors in their decision to enroll and persist in a STEM-related Ph.D. program at the University of Oregon. I began by assessing the validity of the Motivated Strategies for Learning Questionnaire (MSLQ), a survey instrument based on SRL constructs and generally used at the undergraduate level (see, for example, Pintrich, 2004, 1991; Zusho, 2011), to ensure that this survey could be used to better understand the motivation/affect and behavior of female Ph.D. students in STEM-related fields at the University of Oregon. The survey was followed by focus groups with a diverse range of female students in STEM-related programs, both in terms of race/ethnicity and program of study. Implications from this mixed methods study suggest ways that UO – and other universities – can implement programs and practices to support and encourage the enrollment and persistence of female Ph.D. students in STEM-related fields.

Discussion of RQ1: Validity of MSLQ

The standard MSLQ has a total of 81 questions aligned with two scales (motivation and learning strategies) and fifteen factors. I opted to include 28 of the questions covering six of the fifteen factors and made slight modifications to the wording of some of the questions to align with my study population and purpose (e.g., I changed “this class” to “my program” since my study participants were responding about their program of study, not a particular course within their program). Although the MSLQ manual attests that the questions can be adapted per the needs of a particular research study, and not all questions need to be included, I felt it was important to test whether the survey instrument worked in the way in which it was designed, so conducted a factor analysis of my adapted survey, which showed reasonable validity for each of the six factors, as described in Chapter Four.

Validity improvements. Although the factor analysis supported the inclusion of all six factors in my study, I recommend further adaptions to increase the utility of the instrument. For example, the MSLQ items related to intrinsic goal orientation address concepts regarding students’ preferences regarding coursework level of difficulty. The focus groups and literature review findings suggest that intrinsic goal orientation for graduate students also includes aspects of family influence, peer support, and career aspirations. The MSLQ could add or adapt questions to capture these additional aspects of intrinsic motivation. For example, one MSLQ question related to intrinsic goal orientation asked, “In a class like this, I prefer course material that really challenges me so I can learn new things." This question could be re-written for graduate students as follows: "In a course like this, I prefer to learn course material that has direct alignment with my career aspirations." Another adaptation could be to change the MSLQ question of "the most satisfying thing for me in this class is trying to understand the content as thoroughly as possible" to be more applicable to doctoral students planning to teach by wording the question as "the most satisfying thing in this course is trying to understand the content as thoroughly as possible so I can later teach this content to others."

Similar adaptations could be made to the questions aligned with the extrinsic goal orientation factor. According to the findings from the focus groups and literature review, funding during the program and potential future earning are important aspects of extrinsic goal orientation for doctoral students. The MSLQ questions aligned with extrinsic goal orientation could be revised to capture the importance of funding to doctoral students. For example, the MSLQ question that of "getting good grades in my program is the most satisfying thing for me right now" could be adapted to ask, "having funding during in my program is a satisfying thing for me right now." Similarly, the MSLQ question "the most important thing for me right now is improving my overall GPA, so my main concern in this program is getting good grades" could be adapted to ask "one of the most important things for me right now is to increase my research experience, so one concern in this program is having available research funds."

Although the MSLQ factor constructs have been validated for my study, further differentiating the questions may better capture the motivation and learning strategies specific to doctoral students. With these types of adaptations, future research could administer the MSLQ without the need for follow-up focus groups, facilitating a larger scale study at multiple universities.

Discussion of RQ2: Underrepresented and Non-underrepresent Student Differences

One critical component to strengthening scientific advancement in the U.S. is building a more robust workforce in STEM-related fields (National Academies, 2010a, 2010b; Ong et al., 2011) and an area particularly ripe for growth is enhancing the diversity of STEM graduates by supporting the enrollment and persistence of underrepresented[1] female students of color in STEM-related fields. The current population of underrepresented female Ph.D. students (n = 20) in STEM-related fields at the University of Oregon mirrors the challenges of diversifying the STEM workforce.

Barriers per group. The focus group findings uncovered a few notable differences between underrepresented and non-underrepresented students. As described in Chapter Four, underrepresented female students discussed the lack of a community of color at the University of Oregon (UO), which included peers as well as faculty of color. These findings suggest that diversity goals may be strengthened through explicit practices and programs such diversity cluster hires and/or the recruitment of diverse student cohorts to reduce the isolation study participants described. Current underrepresented doctoral students in STEM-related programs could be paired with a faculty member of color outside of their department as an informal mentor; additional informal networking opportunities could be provided through weekly gatherings and events targeted at bridging racial/ethnic divides among UO student populations.

[1] Underrepresented students are defined as: African American, Hispanic and Native American and non-underrepresented students are defined as: White and Asian for this particular study.

Non-underrepresented female Ph.D. students focused more heavily than their underrepresented counterparts on experiences with sexism and the challenges of juggling motherhood and the demands of their doctoral program. As with the suggestions about reducing racial/ethnic isolation, female non-underrepresented doctoral students could be provided a female faculty member mentor outside of their department as a way to voice unfair treatment to a supportive advocate without fear of department repercussions. Challenges related to maternal circumstances could be alleviated through greater access to affordable on campus child care as a way to both support the retention of current students as well as encourage more female students to enroll in Ph.D. STEM-related programs by showcasing family-friendly programs during recruitment efforts and enrollment decisions.

Discussion of RQ3: Motivation differences associated with enrollment and persistence.

The focus groups conducted during phase II of the study established the importance of the factors from the self-regulated learning (SRL) framework and the literature review. Two additional factors emerged from the focus groups: sexism and maternal circumstances. Sexism as a factor was not surprising, given that the study participants were from male-dominated STEM-fields. Similarly, maternal circumstances are more prevalent among doctoral students than undergraduate students. As mentioned above, the MSLQ could be adapted to address these characteristics for similar studies of doctoral students in STEM-related programs.

Another consideration for instrument refinement concerns whether study participants are in the first year of their program, years 2-3, or have advanced to candidacy. Stage in the program seemed particular variable based on year in the program. My study participants were mostly advanced doctoral students, and ranked test anxiety as the lowest factor in the nominal group technique (NGT) ranking process, but suggested that test anxiety was a more important factor earlier in their program. While these comments were anecdotal in my study, a larger scale study could determine more robustly whether other test anxiety, and other SRL factors included in the MSLQ, are dependent on stage in the program.

Summary

My sequential explanatory mixed methods study examined the experiences and perceptions of female Ph.D. students in STEM-related fields at the University of Oregon. An examination of the psychometric properties of scores on the MSLQ survey instrument suggested that a six-factor soution be retained. Although some items on the MSLQ could be rewritten to reflect the specific needs of graduate students, students in STEM-related fields, and underrepresented students, the internal consistency of the questions was reasonable, with Cronbach alpha scores ranging from .552 to .879. The nominal group technique further established the importance of retaining the six MSLQ factors. Results from the qualitative focus groups also supported the six-factor solution and uncovered two additional factors, sexism and maternal circumstances, that play a role in female Ph.D. students' motivation to enroll and persist in STEM-related programs.

Limitations of the Study

Although the explanatory mixed methods study design provided triangulation of data collection activities and analysis methods, there are several limitations to my study. First as a descriptive study, causal relationships cannot be inferred, limiting the interpretation of findings to factors associated with the study participants' perceptions and experiences. In addition, the population of the underrepresented female doctoral students in STEM-related programs at UO is very small; the list provided by Institutional Research included only 20 current students. Although 18 of these 20 students completed the survey, the small sample size limited the statistical power needed to find statistically significant differences among student responses. Further, the survey was anonymous, making it impossible to determine the representativeness of the participants (n = 48%) to the population of female Ph.D. students at the University of Oregon (UO), which may impact external validity. Finally, participation was voluntary in my study. As with any self-administered survey, there is the possibility that participants will respond truthfully or will lack the detail needed to fully understand the questions.

Researcher bias. Creswell (2014) describes the challenge of researcher bias in qualitative research. Researcher bias can introduce error during the process of coding and interpretation of study findings. Creswell (2014) states, "Good qualitative research contains comments by the researchers about how their interpretation of the findings is shaped by their background, such as their gender, culture, history, and socioeconomic origin" (p. 202). As the primary investigator on this dissertation project, my background as an underrepresented doctoral student in education and personal experience with barriers at UO was what first interested me in this study topic. I decided to include students outside of the College of Education in an attempt to minimize researcher bias, as students in STEM-related fields were able to speak more candidly about their experiences, knowing that I had no affiliation with their departments.

Researcher positionality also has advantages in qualitative research. My identity as an underrepresented female doctoral student likely increased students' comfort sharing their experiences face-to-face in the focus groups. Further, my undergraduate experiences as a major in a STEM field likely added legitimacy in my participants' view and helped me more accurately interpret the findings based on my personal knowledge of STEM-related education. Finally, as a student in EMPL's D.Ed. rather than Ph.D. program, I was able to convey to study participants the applied nature of my research and the hope that my dissertation findings could help UO shape programs and practices aimed at supporting female doctoral students in STEM-relayed fields.

Future Research

The overall purpose of the current research was to improve understanding of what motivates female Ph.D. students' decision to enroll and persist in STEM-related fields at the University of Oregon. My cross-sectional study described the experiences and perceptions of current female Ph.D. students in STEM-related fields at the University of Oregon. Future multi-site research should be conducted to compare experiences across several institutions with diverse student demographics. Another future research topic would be to conduct a longitudinal study to investigate the motivation of female Ph.D. students over the scan of time they are in a program. A longitudinal study would help identify the program stages in which help-seeking and self-doubt is most prominent so that universities could better tailor programs and supports to increase female Ph.D. students' enrollment and persistence in STEM-related Ph.D.

Lastly, given the finding that 88.78% of survey respondents answered the self-doubt question as a six or seven (highest levels of agreement that they have self-doubt), future research could conduct a risk analysis to see how self-doubt interacts with other student characteristics such as race/ethnicity or funding status.

Implications

This section provides implications for practice including implicit bias training for faculty, students, and staff, subsidized child-care, proactive faculty and peer mentoring, and increasing female faculty and students in STEM-related fields trough cluster hires and targeted student recruitment.

Implicit bias training. The findings from my study suggest that sexism is a contributing factor to the barriers female Ph.D. students in STEM-related fields face in finding supportive mentorship at the University of Oregon (UO). This factor can play a negative role in several areas such as climate, mentorship, faculty support and guidance, and help seeking. Sexism can be addressed through a number of actions. Implicit bias training for faculty, students, and staff can help create a safe and inclusive environment in STEM-related departments at the UO, which could increase enrollment and persistence.

Proactive faculty and peer mentoring. Help seeking resources and opportunities should also be considered for future practice in STEM-related fields at the UO. The help-seeking factor puts the impetus on the student, whereas UO could create formal programs to increase help-seeking behaviors. For example, students of color mentioned lacking community and support from their family and friends when they moved to Oregon to enroll at UO. Departments could alleviate isolation by assigning student an informal faculty mentor in addition to their academic advisor. The literature review and findings of this study state the importance of faculty support and training and how those supports can either positively or negatively affect outcomes of enrollment and persistence (Ong, Wright, Espinosa, & Orfield, 2011; Witherspoon, 2018). Therefore, rethinking student to faculty relationships and supports should be considered along with interdisciplinary partnerships for students of color to have a faculty of color mentor to promote positive outcomes for female Ph.D. students in STEM-related fields.

Peer support was another finding study participants suggested was associated with their enrollment and persistence in STEM-related programs. The help-seeking factor from the MSLQ focuses on the importance of social interaction (Pintrich, 2004); UO STEM-related departments could proactively assign students with a peer mentor, or a range of peer mentors such as a second or third year student within their department and a peer in their entering class from outside of their department. The department peer mentor could support first year students by providing “road maps” of important activities to engage in (e.g., conferences and publication opportunities) as well as peer support on coursework and program guidance. A peer from another department could provide informal support trough social interactions outside of the department. Proactively providing students two different types of peer support would minimize feelings of isolation. For example, a first year student might be embarrassed to ask a more advanced student in their department a program or content-related question; an explicit mentor program would create an environment where such questions were the norm. Further, being assigned a mentor from outside the department student supports the social and emotional well-being literature that suggests that enhancing students’ wellbeing has implications for improving their quality of life and the communities they inhabit (Renshaw, 2016). According to Rubin (2016), a negative university experience can worsen depression and anxiety levels for students; creating a proactive mentorship program for positive social and emotional wellbeing by pairing students with peers could increase positive outcomes for students.

Subsidized child-care. Another implication for practice that should be considered to support female Ph.D. students in STEM-related fields is to provide subsidized child care to supplement the limited funding provided by a graduate employee (GE) research or teaching position. Childcare costs were mentioned as a barrier in the focus groups by study participants who noted that the prohibitive costs associated with childcare plays a role in their enrollment and persistence in STEM-related Ph.D. programs. If UO aims to increase the female populations of Ph.D. students in STEM-related fields, they should consider a discount or waiver for childcare support.

Cluster hires and targeted student recruitment. A final implication for UO is to dedicate resources to increase the number of diverse female faculty. One way to do this would be for the university to apply for an NSF ADVANCE, which provides funding to increase the number of female faculty on campus. According to UO's department of Institutional Research, the College of Arts and Sciences at the University of Oregon (which houses STEM-related department) has 44.6% female faculty and 14.2% faculty of color. The participants in my study suggested that if there were more women in their fields, instances of overt sexism would likely be less frequent. The literature states the importance of recognizing the culture of STEM departments based on "interpersonal relationships—including isolation, racism, sexism, being racially/ethnically identifiable, and relationships with faculty and other peers… played out as microaggressions in the everyday practice of graduate programs, affecting student experiences" (Ong, Wright, Espinosa & Orfield, 2011, p. 192). The percentage of underrepresented women of color earning masters and doctoral degrees in STEM-related fields is not on par with the population. Although women of color represented 29.8 percent of the nation's populace aged 18-24 years in 2015 (U.S. Census Bureau, 2015), women of color attained only 18.6 percent of the total masters degrees and 1.7 percent of the total doctoral degrees (NSF, 2014). Underrepresented women of color represent untapped human capital that could provide a much-needed force for sustaining America's economic vitality (CEOSE, 2009 and forthcoming; National Academies 2010a, 2010b). "As the U.S. demographics of higher education students nationwide rapidly shift towards becoming majority minority and majority female, minorities and women, especially women of color, are rapidly considered untapped sources of domestic talent that could fill the country's current and future scientific workforce needs" (Ong 2010, p. 8).

Changing the STEM culture at the University of Oregon by increasing the percentage of female faculty, and female faculty of color, could create a diverse and inclusive academic space for all students. As Espinosa (2011) put it, "The distinct importance is the argument for STEM college faculty that resembles our nation's increasingly diverse student body" (p. 211).

This study has the possibility to inform STEM-related departments at the UO about the experiences of female Ph.D. students in their programs. As mentioned earlier, the six MSLQ factors (i.e. intrinsic goal orientation, extrinsic goal orientation, self-efficacy, control of learning beliefs, test anxiety, and help seeking) and two additional factors (sexism and maternal circumstances) were shown to be associated with enrollment and persistence of female Ph.D. students in STEM-related fields. The results of this study and the implications discussed above suggest the need for UO to implement programs, practices, and strategies to support female Ph.D. students in STEM-related fields.

Action Plan to Disseminate Research

I plan to disseminate findings from this study through publication of a scholarly article, which will involve the following steps:

- First, I will select an appropriate journal for submission of an article that aligns with my study topic, such as: *Journal of Diversity in Higher Education, Journal of Student Affairs Research and Practice, Journal of Education Psychology*, *or Educational and Psychological Measurements.* These journals all published articles included in my literature review. In this first step, I would review the titles of the most recent editions of these journals to gauge a fit for my dissertation findings.
- Secondly, I will review the submission guidelines for each journal deemed a potential fit from step 1 to find the page limits for article submissions. In this step, I would review the articles from recent editions of the journals to help me tailor my submission based on the relative space dedicated to theoretical framework, study methods, findings, or implications for practice. Having reviewed a range of articles for my literature review, I know that I will have to pitch my scholarly article in different ways to meet the standards and focus for different journals.
- Third, I will determine how many articles to submit. Potentially, I may submit one article highlighting the qualitative findings from the focus groups, one focused on higher education policy and practice, and one focused on the factor analysis assessing the psychometric properties of the MSLQ measure.

- Lastly, I will submit articles for publication. These publications can enhance my career trajectory in academic affairs post-graduation.

APPENDIX A

ADAPTED MSLQ SURVEY INSTRUMENT

1. In a program like this, I prefer course material that really challenges me so I can learn new things? (MSLQ—1)
2. If I study in appropriate ways, then I will be able to learn the material in the course? (MSLQ—2)
3. When I take a test I think about how poorly I am doing compared with other students? (MSLQ—3)
4. I believe I will receive excellent grades in the program? (MSLQ—5)
5. I'm certain I can understand the most difficult material presented in the readings for this program? (MSLQ—6)
6. Getting good grades in my program is the most satisfying thing for me right now? (MSLQ—7)
7. When I take a test I think about items on other parts of the test I can't answer? (MSLQ—8)
8. It is my own fault if I don't learn the material in my program? (MSLQ—9)
9. The most important thing for me right now is improving my overall GPA, so my main concern in this program is getting good grades? (MSLQ—11)
10. I'm confident I can learn the basic concepts taught in my program? (MSLQ—12)
11. When I take tests I think of the consequences of failing? (MSLQ—14)
12. I'm confident I can understand most complex material presented by the instructors in my program? (MSLQ—15)
13. In a program like this, I prefer course material that arouses my curiosity, even if it is difficult to learn? (MSLQ—16)
14. If I try hard enough, then I will understand the course material? (MSLQ—18)
15. I have an uneasy, upset feeling when I take an exam? (MSLQ—19)
16. I'm confident I can do an excellent job on the assignments and tests in my program? (MSLQ—20)
17. I expect to do well in this program? (MSLQ—21)
18. The most satisfying thing for me in this program is trying to understand the content as thoroughly as possible? (MSLQ—22)
19. When I have the opportunity in this program, I choose course topics that I can learn from even if they don't guarantee a good grade? (MSLQ—24)
20. If I don't understand course material it is because I didn't try hard enough? (MSLQ—25)
21. I feel my heart beating fast when I take an exam? (MSLQ—28)
22. I'm certain I can master the skills being taught in my courses? (MSLQ—29)
23. I want to do well in my course work because it is important to show my ability to my friends, family, employer, or others? (MSLQ—30)
24. Considering the difficulty of my program, the advisor, and my skills, I think I will do well in my program? (MSLQ—31)
25. Even if I have trouble learning the material in my program, I try to do the work on my own, without help from anyone? (MSLQ—40)
26. I ask my advisor to clarify concepts I don't understand well? (MSLQ—58)

27. When I can't understand the material in my program, I ask another student in the course for help? (MSLQ—68)
28. I try to identify cohort members in the course whom I can ask for help if necessary? (MSLQ—75)

Additional Self-doubt questions:

29. I have experienced self-doubt during my program.
30. I feel I am doing well in my program.
31. I'm on track to finish my program within the seven years allowed by graduate students.
32. Have you received any incompletes during your coursework (not during the dissertation).
33. Have you failed any classes.

APPENDIX B

ORIGINAL MSLQ SURVEY INSTRUMENT

1. In a class like this, I prefer course material that really challenges me so I can learn new things.
2. If I study in appropriate ways, then I will be able to learn the material in this course.
3. When I take a test I think about how poorly I am doing compared with other students.
4. I think I will be bale to use what I learn in this course in other courses.
5. I believe I will receive an excellent grade in this class.
6. I'm certain I can understand the most difficult material presented in the readings for this course.
7. Getting good grades in this class is the most satisfying thing for me right now.
8. When I take a test I think about items on parts of the test I can't answer.
9. It is my own fault if I don't learn the material in this course.
10. It is important for me to learn the course material in this class.
11. The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.
12. I'm confident I can learn the basic concepts taught in this course.
13. If I can, I want to get better grades in this class than most of the other students.
14. When I take tests I think of consequences of failing.
15. I'm confident I can understand the most complex material presented by the instructor in this course.
16. In a class like this, I prefer course material that arouses my curiosity even if it is difficult to learn.
17. I am very interested in the content area of this course.
18. If I try hard enough, then I will understand the course material.
19. I have an uneasy, upset feeling when I take an exam.
20. I'm confident I can do an excellent job on the assignments and tests in this course.
21. I expect to do well in this class.
22. The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.
23. I think the course material in this class is useful for me to learn.
24. When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.
25. If I don't understand the course material, it is because I didn't try hard enough.
26. I like the subject matter of this course.
27. Understanding the subject matter of this course is very important to me.
28. I feel my heart beating fast when I take an exam.
29. I'm certain I can master the skills being taught in this class.
30. I want to do well in this class because it is important to show my ability to my family, friends, employer, or others.

31. Considering the difficulty of this course the teacher, and my skills, I think I will do well in this class.
32. When I study the readings for this course, I outline the material to help me organize my thoughts.
33. During class time I often miss important points because I'm thinking of other things.
34. When studying for this course, I often try to explain the material to a classmate or friend.
35. I usually study in a place where I can concentrate on my course work.
36. When reading for this course, I make up questions to help focus my reading.
37. I often feel so lazy or bored when I study for this class that I before I finish what I planned to do.
38. I often find myself questioning things I hear or read in this course to decide if I find them convincing.
39. When I study for this class, I practice saying the material to myself over and over.
40. Even if I have trouble learning the material in this class, I try to do the work on my own, without help from anyone.
41. When I become confused about something I'm reading for this class, I go back and try to figure it out.
42. When I study for this course, I go through the readings and my class notes and try to find the most important ideas.
43. I make good use of my study time for this course.
44. If course readings are difficult to understand, I change the way I read the material.
45. I try to work with other student from this class to complete the course assignments.
46. When studying for this course, I read my class notes over and over again.
47. When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence.
48. I work hard to do well in this class even if I don't like what we are doing.
49. I make simple charts, diagrams, or tables to help me organize course material.
50. When studying for this course, I often set aside time to discuss course material with a group of students form the class.
51. I treat the course material as a starting point and try to develop my own ideas about it.
52. I find it hard to stick to a study schedule.
53. When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions.
54. Before I study new course material thoroughly, I often skim it to see how it is organized.
55. I ask myself questions to make sure I understand the material I have been studying in this class.
56. I try to change the way I study in order to fit the course requirements and the instructor's teaching style.
57. I often find that I have been reading for this class but don't know what it was all about.
58. I ask the instructor to clarify concepts I don't understand well.

59. I memorize key words to remind me of important concepts in this class.
60. When course work is difficult, I either give up or only study the easy parts.
61. I tyr to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying for this course.
62. I try to relate ideas in the subject to those in other courses whenever possible.
63. When I study for this course, I go over my class notes and make an outline of important concepts.
64. When reading for this class, I try to relate the material to what I already know.
65. I have a regular place set aside for studying.
66. I try to play around with ideas of my own related to what I am learning in this course.
67. When I study for this course, I write brief summaries of the main ideas form the readings and my class notes.
68. When I can't understand the material in this course, I ask another student in this class for help.
69. I try to udnerstnadn the material in this class by making connections between the readings and concepts form the lectures.
70. I make sure that I keep up with the weekly readings and assignments for this course.
71. Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives.
72. I make lists of important items for this course and memorize the lists.
73. I attend this class regularly.
74. Even when course materials are dull and uninteresting, I manage to keep working until I finish.
75. I try to identify students in this class whom I can ask for help if necessary.
76. When studying for this course I try to determine which concepts I don't understand well.
77. I often find that I don't spend very much time on this course because of other activities.
78. When I study for this class, I set goals for myself in order to direct my activities in each study period.
79. If I get confused taking notes in class, I make sure I sort it out afterwards.
80. I rarely find time to review my notes or readings before an exam.
81. I try to apply ideas from course readings in other class activities such as lecture and discussion.

APPENDIX C

FOCUS GROUP PROTOCOL

Master Field Notes: STEM Follow-up Focus Group
Date
Time
University of Oregon—Lokey 102G

<u>Facilitator Agenda</u>

Note-taker Assignments (Convene at *Time* to discuss any changes to agenda/plan)

Notetaker: PI--Facilitator: Lauren Witherspoon: LW	Participants: Can put initials AA: Name XX: If you missed who previously spoke.

Session Title:	Format of Session	Notetaker Instructions
STEM Follow up-- Focus Group	Whole Group Notetaking	Take notes during the focus group. You can put student initials while recording. If you forget who previously spoke put XX.
<u>Question 1:</u> **What are factors that encouraged/prompted you to persist in your field to seek a Ph.D. in STEM?** **(15 mins)**	Whole group	
<u>Question 2:</u> **What are barriers that you had to overcome to pursue this degree?** **(15 mins)**	Whole group	

<u>**Question 3:**</u> **What supports do you wish you had?** **(15 mins)**	Whole Group	
		How many votes:
Ranking of Factors: **(15 mins)** How many votes did each factor receive? --Place the number of votes beside each one so we can keep track of tally marks for the importance.	Whole Group	
Vote as a group on the top factors by consensus.	Whole Group: *Nominal Group Technique*	**#1:** **#2:** **#3:** **#4:** **#5:** **#6:**

APPENDIX D

FOCUS GROUP THEMES BY SRL TOPIC & ADDITIONAL FACTORS

Intrinsic Goal Orientation

I. Positive Intrinsic Supports =

- **Family Influence and Support**
    - Strong Science family support--1
    - Mom role model in the importance of education--
    - Mother had Ph.D. in Science --(Family role model)--1
    - Ph.D. in family—so family was supportive-
    - Family Support--1
    - Spousal hire--2
    - Spousal support--2
    - Family and friend support f/ back home—2
    - Mom role model in the importance of education--1
- **Peer support**
    - Community of Color--Support after moving--1
    - Community of Color--Adjusting to her new living environment--1

- **Love of knowledge (new finding)**
    - Had unanswered questions in her fields—2
    - Love for animals/science topics--1

- **Career Interests (New finding)**
    - Wants to be a therapist--1
    - Stayed to complete career aspirations--l
    - Wanted to teach teachers--1
    - Knew she had to get Ph.D. for career goals--2
        - Knew she had to get Ph.D. for career goals--2
        - Wanted a Ph.D. since middle--1
        - Become Science prof.--1

II. Negative Intrinsic Supports

- **Family influence and supports**
    - Leaving family--2
    - Being away from family--5
    - Moving out of state away f/family--2
    - Lacking peer and family sibling support—1
    - Family illness--1
    - Lack of Community of color supports--1
- **Peer supports**
    - Lack of students of color--1
    - Lack of Latino community--1

        - Cultural barriers such as female Ph.D. and cultural--1
        - Didn't think she would be understood culturally--1
    - **Career Aspirations**
        - Wanted to pursue other career goals instead in psychology/neuroscience--1
        - Negative career aspiration--3

Extrinsic Goal Orientation

I. Positive Extrinsic Supports =

- **Funds**
    - Positive monetary family support—2
    - Monetary advancement--2
    - Joined bc of Funding--1
    - External person to receive reviews that won't affect student's funding/prof future relationship—1
    - Work experience led to Advanced degree important, even for monetary advancement--3

    Generic

- Externally driven--1
- Motivated by outside factors--1

II. Negative Extrinsic Supports = 43

- Negative Funding--4
- Sacrifice financially—2
    - Financial adjustment--1
- Travel expenses to begin--2
- Apply's for grants to continue research--1
- Daycare costs more than her funding--1
- Pay is different bc of science vs hard science--1

Control Beliefs

I. Positive Control Beliefs = 13

Science Identity

- Avoids Negative Female Stereotype in Science--1
- Find own supports to help—4
    - Found supportive outside committee member—(included in tally marks above)
- **Goals**
    - Focused on little goals--1

- Negative Control Beliefs = 28
    - Lacked motivation, but didn't quick--1
    - Doesn't want to be a statistic of not finishing --5
    - Misperception of science field—1

- Lacked science identity--1

Self-Efficacy

I. <u>Positive Self Efficacy = 9</u>
    - Self driven--2
        - Confidence in self (included in tally marks above)

II. <u>Negative Self Efficacy = 11</u>
    - Lacked graduate identity--1
    - Self doubt--3

Positive Test Anxiety = 1

- **Positive transition pipeline**
    - Worked in research labs and started off pre-med—1
    - Undergrad science experiences were positive--3

Negative Test Anxiety=

- **Climate**
    - Older Female faculty validate/support hazing system—1
    - Changes in dept are slow--1
    - Grad school should check on student experiences/satisfaction—1
    - Felt alone after coursework completion--1
    - Adjusting to her new living environment--
    - Felt judged and neglected by dept--1

- **University systems and structures**
    - Having writing support earlier--1
    - Lack of resources for graduate students in terms of academic help --1
    - Lack of Data/analysis training--1
    - Paid for supports outside of her dept
    - Only academic support--3
    - Fear of dropping out before finishing due to lack of transparency--1
    - Training for faculty/advisors to mentor females fairly--1
    - Couldn't give profs bad reviews--1
    - Negative review could effect GE assignments are linked to funding--1
    - Equitable practices—1
    - External person to discuss prof evals (NEGATIVE)--1
    - Expected to teach every quarter—1
    - Didn't have undergraduate research experiences so had to get Master's first
    - Didn't know evaluation system for higher ed in regards to what it means to sign evals (NEGATIVE)--1

        - Transparency of requirements (NEGATIVE)--2
            - Ph.D. not like undergrad where you knew what the you needed to do to finish—road maps (NEGATIVE)—(included in tally marks above)
        - Grad student resources in processes, dissertation, requirements, experiments, committee, proposal, defense, etc. (NEGATIVE)--1

    - **Grad training and networking**
        - Wasn't prepared to use stats so much in the beginning--1

    - **Pipeline Training**
        - Not satisfied w/undergrad—2
        - Writing supports and resources--2
        - Lab supports (NEGATIVE)--1
        - Lack of research training (NEGATIVE)--2
        - Understanding publishing (NEGATIVE)--1
        - Lack of training for Poster presentation (NEGATIVE)--1

Positive Help Seeking =

- Mentor
    - Had undergrad mentors that were grad students
    - Role Model: Wanted to teach teachers--1
    - Role Model: Importance of teaching--1
    - Role Model: Wanted to be female of color prof—1
    - Female committees to hear ideas that are valued--1
    - Positive female faculty--2
    - Mentor: --5
    - Outreach to join science lab--1

Negative Help Seeking=

    - Mentor
        - Mentor didn't believe in her ideas--1
        - Bad female mentor--1
        - Female faculty maternity leave, or sick no sub advisor support—2
            - Advisor became sick (included in tally marks count above)
        - Advocated & fought for new advisor –1
        - PI's not active daily—1
- Faculty
    - Female PIs are very busy bc few of them--1
    - Lack of Faculty of Color--1
    - Lacking female faculty support--4
    - Isolation f/female faculty—1
    - Differences in male vs female PI--1

Sexism = 9, Positive =1, Negative = 8

- **Positive Sexism**

- Younger female faculty have diff point of view on hazing system—1(Positive)
- Female faculty says no to sexist views—1 (POSITIVE)

- **Negative Sexism**
  - Gender imbalance-- 5
  - Female students required to do more work than male counterparts--1
  - Majority vs. minority--1

  - Bad male profs--
  - Negative attitude about changing hazing system--1
  - Female generational diff in science higher education systems--1
  - Sexist environment f/ male peers not faculty--1
  - Sexist comments--1
  - Male faculty states science is sexist--1
  - Male PI, doesn't recognize female stud problem concerns--1
  - Attempts to reach out to wife "female science PI" to voice concern--1

<u>Maternal---Career vs family = 9, Positive = 2, Negative = 8</u>

- Daycare expenses--1
- Daycare costs more than her funding--1
- Childcare subsidies--1
- Life on hold for family--1
- Pregnant prevent interviewing--1
- Has kids—2
- Childcare supports (POSITIVE)--2

Test Anxiety an area for future study that we need to include people in different stages of the program such as 1st and 2nd year students.

APPENDIX E

INVITATION EMAIL TO PARTICIPANTS

From: lwither6@uoregon.edu
Sent: <Date>
To: respondent@providedemail.com
Subject:

Dear fellow UO student,

My name is Lauren Witherspoon. I am a doctoral student here at UO. I am conducting research an anonymous survey on the motivation and learning strategies of female Ph.D. students in STEM-related programs. You are receiving this invitation because you are registered in a Ph.D. STEM-related program here.

As you know, STEM-related fields are important for our future as a country's future. One critical component to strengthening scientific advancement in the US is building a robust workforce in the STEM fields. You are in a unique position to inform future research around motivational and learning strategies for female Ph.D. student with your responses. Your responses will also be used to make recommendations to UO about better serving women in STEM programs.

The survey is short, only 34 questions, and should take less than 30 minutes. Your participation is voluntary with no risks or benefits to you for your participation. If you agree to participate, you will complete an anonymous survey. By clicking through to the survey, you agree to participate in this research. You may print or save a copy of this consent for your records.

To begin the survey, simply click this link:

https://oregon.qualtrics.com/jfe/form/SV_0kBRRgz6fLbbw3P

If you have any questions or comments please contact Lauren Witherspoon, Principal Investigator, at 214-770-9556 or lwither6@uoregon.edu; the faculty advisor for this research is Dr. Joanna Smith at jos@uoregon.edu, or Research Compliance Services at ResearchCompliance@uoregon.edu .

Sincerely,

Lauren Witherspoon
Principal Investigator & D.Ed. Candidate
University of Oregon

APPENDIX F

FOLLOW-UP EMAIL

From: lwither6@uoregon.edu
Sent: <Date>
To: respondent@providedemail.com
Subject: MSLQ Survey—Response Requested

Greetings!

Last week, I emailed you an invitation to help us better understand differences that female Ph.D. students in STEM-related fields face at the UO. I am conducting a research study on the motivation and learning strategies of female Ph.D. students in STEM-related fields.

Because this survey is anonymous we are unable to track who has completed the survey from my invitation list, so thank you if you have already completed the survey. If you have not completed the survey, you still have an opportunity to have your voice heard. There are about 250 female students in STEM-related programs here.

There are no risks or benefits to you for your participation. The survey will take less than 30 minutes. If you agree to participate, you will complete and anonymous survey:

https://oregon.qualtrics.com/jfe/form/SV_0kBRRgz6fLbbw3P

Thank you for your participation. You can print or save a copy of this consent for your records. If you have questions or concerns about this survey project or would like to volunteer for follow up interviews, please contact Lauren Witherspoon at 214-770-9556 or email at: lwither6@uoregon.edu.

Sincerely,

Lauren Witherspoon
Principal Investigator & D.Ed. Candidate
University of Oregon

APPENDIX G

SECOND FOLLOW-UP EMAIL

From: lwither6@uoregon.edu
Sent: <Date>
To: respondent@providedemail.com
Subject: 2^{ND} Chance to Participate in MSLQ Survey—Response Requested

Dear fellow UO student,

My name is Lauren Witherspoon. I am a doctoral student from the University of Oregon. I am conducting a research study on the motivation and learning strategies of female Ph.D. students in STEM-related programs. If you agree to participate, you will complete an anonymous survey. I've sent a couple of emails, although I apologize if this is redundant.

If you haven't completed the survey, it is not too late: the survey will be open for another five days.

https://oregon.qualtrics.com/jfe/form/SV_okBRRgz6fLbbw3P

If you have any questions or comments please contact Lauren Witherspoon, Principal Investigator, at 214-770-9556 or lwither6@uoregon.edu; the faculty advisor for this research is Dr. Joanna Smith at jos@uoregon.edu, or Research Compliance Services at ResearchCompliance@uoregon.edu .

Sincerely,

Lauren Witherspoon
Principal Investigator & D.Ed. Candidate
University of Oregon

APPENDIX H

FINAL FOLLOW-UP EMAIL TO PARTICIPANTS

From: lwither6@uoregon.edu
Sent: <Date>
To: respondent@providedemail.com
Subject: MSLQ Survey—Response Requested

Greetings!

You have received several emails regarding your participation in a dissertation research study on the motivation and learning strategies of female Ph.D. students in STEM-related fields. If you agree to participate, you will complete an anonymous survey about looking at differences between female Ph.D. students' in STEM-related fields face at the University of Oregon. This survey is in the final week. Because the survey is anonymous I have no way of knowing who has completed it. If you have already helped us better understand the processes, pressures, and factors as a female Ph.D. student in STEM-related fields, I want to thank you!

If you have not completed the survey, we are providing this last opportunity to have your voice heard. There are over 250 female students identified in Ph.D. STEM-programs at the University of Oregon and we want to ensure that the identification process is fair for all female Ph.D. students to have the opportunity to help inform future research.

The survey is anonymous and voluntary. It will take less than 30 minutes. The survey will close this Friday at 5:00 p.m. There are no risks or benefits to you for your participation.

https://oregon.qualtrics.com/jfe/form/SV_0kBRRgz6fLbbw3P

Thank you for your participation. The study will also be interviewing participants to gain deeper insights about the contextual factors and influences on enrollment and persistence in STEM-related fields. If you are interested in volunteering for follow up interviews, please contact Lauren Witherspoon at 214-770-9556 or email at: lwither6@uoregon.edu.

Sincerely,

Lauren Witherspoon
Principal Investigator & D.Ed. Candidate
University of Oregon

APPENDIX I

FOCUS GROUP SCHEDULING EMAIL

Dear Participant,

Thank you for completing the recent MSLQ survey and expressing interest in a participation in a follow-up focus group. Your participation is voluntary, but greatly appreciated. I am contacting you to schedule a time that is convenient for you for an hour-long focus group interview. Attached below is the Qualtrics link to fill in possible dates and times you are available. There are no risks or benefits for your focus group interview participation. You will have an opportunity before the focus group begins to provide verbal consent to participate and give or deny permission to have the researcher record the interview for transcription.

As I noted in the survey, this research study will be used to help us better understand the motivation of female Ph.D. students to enroll and persist in a STEM-related field. The focus groups will help me to better understand survey results and the experiences that female Ph.D. students in STEM-related fields at the University of Oregon face within their programs.

Your responses and identity will remain confidential. You may save or print this consent information for your records.

If you have questions or comments please contact Lauren Witherspoon, Principal Investigator, at 214-770-9556 or lwither6@uoregon.edu; the faculty advisor for this research, Dr. Joanna Smith at jos@uoregon.edu ; or Research Compliance Services at ResearchCompliance@uoregon.edu .

Qualtrics Link: https://oregon.qualtrics.com/jfe/form/SV_4ItidRSY5xntnHT

APPENDIX J

SCHEDULED DATE/TIME/LOCATION FOCUS GROUP INTERVIEWS

Dear Participant,

Thank you for completing the survey to schedule your follow-up focus group. Your focus group time has been set for <date> at <time> at <location>. Remember there are no risks or benefits for your focus group interview participation. You will have an opportunity before the focus group begins to provide verbal consent to participate and give or deny permission to have the researcher record the interview for transcription.

As I noted in the survey, this research study will be used to help us better understand the motivation of female Ph.D. students to enroll and persist in a STEM-related field. The focus groups will help me to better understand survey results and the experiences that female Ph.D. students in STEM-related fields at the University of Oregon face within their programs.

If you have questions or comments please contact Lauren Witherspoon, Principal Investigator, at 214-770-9556 or lwither6@uoregon.edu; the faculty advisor for this research, Dr. Joanna Smith at jos@uoregon.edu ; or Research Compliance Services at ResearchCompliance@uoregon.edu .

Best,

Lauren Witherspoon

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