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Entitled

Belonging Uncertainty and Psychological Capital: An Investigation of Antecedents of the Leaky Pipeline in STEM

For the degree of Master of Science

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BELONGING UNCERTAINTY AND PSYCHOLOGICAL CAPITAL:  
AN INVESTIGATION OF ANTECEDENTS OF THE LEAKY PIPELINE IN STEM

A Thesis

Submitted to the Faculty

of

Purdue University

by

Gina A. Seaton

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Science

August 2011

Purdue University

Indianapolis, Indiana

## ACKNOWLEDGMENTS

I would like to thank my committee chair Jane Williams for her support, guidance, and dedication throughout my thesis process. I would also like to thank my committee members Leslie Ashburn-Nardo and Kevin Rand for their insight and valuable contributions to my thesis.

Additionally, I would like to give a special thank you to Jane Williams and Leslie Ashburn-Nardo for the positive impact they have had on my time at IUPUI. They are outstanding researchers, teachers, and mentors who provide an excellent example for female students in STEM.

## TABLE OF CONTENTS

	Page
LIST OF TABLES .....	iv
LIST OF FIGURES .....	v
ABSTRACT.....	vi
CHAPTER 1. INTRODUCTION .....	1
1.1. Background and Rationale.....	1
1.2. Previous Theory and Research.....	3
1.3. Present Study .....	11
CHAPTER 2. METHOD .....	13
2.1. Participants.....	13
2.2. Design .....	14
2.3. Measures .....	14
2.4. Procedure .....	18
2.5. Statistical Analyses .....	18
CHAPTER 3. RESULTS .....	20
3.1. Preliminary Analyses.....	20
3.2. Hypotheses Tests .....	21
3.3. Additional Analyses.....	29
CHAPTER 4. DISCUSSION.....	40
4.1. Contributions .....	46
4.2. Limitations and Future Research .....	49
4.3. Conclusion .....	50
LIST OF REFERENCES.....	51
APPENDICES	
Appendix A.....	84
Appendix B.....	97

## LIST OF TABLES

Table	Page
Table 1 Correlations between Variables at Time One .....	58
Table 2 Correlations between Variables at Time Two .....	59
Table 3 Correlations between Variables at Time One and Time Two .....	60
Table 4 Mediation Analyses .....	61
Table 5 Hierarchical Regression Analyses of Belonging-PsyCap Interaction .....	62
Table 6 Table 6 Significant Mediated Effects by Group .....	64
Table 7 Significant Hierarchical Regression Analyses of Belonging-PsyCap Interaction by Group .....	65
Table 8 Significant Hierarchical Regression Analyses of Belonging-Engagement Interaction for Entry-Level Students .....	66
Table 9 Significant Hierarchical Regression Analyses of Belonging-Engagement Interaction for Advanced Students.....	67
Table 10 Summary of Supported Hypotheses .....	68
Table 11 Mean Differences between Entry-Level Students and Advanced Students on All Investigated Variables.....	69

## LIST OF FIGURES

Figure	Page
Figure 1 Ashburn-Nardo and Williams (2009): The Relationship between Belonging Uncertainty and Everyday Sexism in an Academic Setting .....	70
Figure 2 PsyCap as a Mediator in Ashburn-Nardo and Williams' (2009) model .....	71
Figure 3 PsyCap as a Moderator in Ashburn-Nardo and Williams' (2009) model .....	72
Figure 4 Mediated Model.....	73
Figure 5 Interaction between Sense of Belonging and PsyCap In Relation to Participant Intentions to Switch Majors .....	74
Figure 6 Interaction between Sense of Belonging and PsyCap in Relation to Participant Intentions to Apply to Graduate Programs in an Unrelated Area.....	75
Figure 7 Interaction between Sense of Belonging and PsyCap In Relation to Participant Intentions to Seek a Job in a Clinical/Applied Setting .....	76
Figure 8 Interaction between Sense of Belonging and PsyCap in Relation to Intentions to Switch Majors By Group .....	77
Figure 9 Interaction between Sense of Belonging and PsyCap in Relation to Intentions to Apply to Graduate Programs in an Unrelated Area by Group.....	78
Figure 10 Interaction between Sense of Belonging and Engagement in Relation to Cognitive Psychological Well-Being (GHQ) by Group .....	79
Figure 11 Interaction between Sense of Belonging and Engagement in Relation to Satisfaction With Life (SWL) by Group.....	80
Figure 12 Interaction between Sense of Belonging and Engagement in Relation to Intentions to Apply to Graduate Programs in an Unrelated Area by Group.....	81
Figure 13 Interaction Between Sense of Belonging and Engagement in Relation to Intentions to Seek a Career Where Research is a Major Focus by Group.....	82
Figure 14 Interaction between Sense of Belonging and Engagement in Relation to Intentions to Seek a Job in a Clinical/Applied Setting by Group .....	83

## ABSTRACT

Seaton, Gina, A., M.S., Purdue University, August 2011. *Belonging Uncertainty and Psychological Capital: An Investigation of Antecedents of the Leaky Pipeline in STEM.* Major Professor: Jane R. Williams.

Women are underrepresented in science, technology, engineering, and math fields (STEM), especially in higher levels. Researchers term this phenomenon “the leaky pipeline.” While the issue is well-documented in the literature, little is known about its antecedents. The current study offers insight into factors that relate to career choice and contribute to the lack of diversity in STEM fields by investigating how sense of belonging and psychological capital (PsyCap) influence important psychological, academic, and career outcomes for women in these fields. Female undergraduate STEM majors were recruited for participation at two times during the fall academic semester (N=182 at time one, N=86 at time two) and data were analyzed using correlation and regression. Results provide support for the influence of both sense of belonging and PsyCap as important correlates of an individual’s academic and career making decisions. Specifically, PsyCap mediated the relationship between belonging and well-being and belonging and career outcomes of engagement and participants’ intentions to apply to graduate programs in an unrelated major. In addition, PsyCap moderated the relationship between sense of belonging and participants’ intentions to switch majors and intentions to apply to graduate programs in a field unrelated to their current major. An increased understanding of the factors that contribute to the leaky pipeline in STEM will serve as a basis for developing further research questions and targeting interventions.

## CHAPTER 1. INTRODUCTION

Increasingly, women have been entering the workforce and obtaining higher levels of education. While there are strong trends in women obtaining bachelor's, master's, and doctoral degrees, these numbers are not consistent with the proportion of women in *all* professional positions and *all* levels of professional positions (Liang & Billimoria, 2007). That is, of the women obtaining higher levels of education, fewer are likely to continue to graduate school in the science and math fields (Madill et al., 2007). The number of faculty and researchers in these fields is not consistent with the number of women who are earning bachelor's degrees in science and engineering. Furthermore, the proportions of women receiving doctoral degrees overall are also not representative of the proportion of women in research and faculty positions (Liang & Billimoria, 2007). For example, recent research among doctoral students across fields found that for women, only 27% of women wanted to be a professor with a research emphasis (Mason, Goulden, & Frasch, 2009). The proposed study hopes to increase our understanding of this trend by investigating factors that contribute to the lack of diversity in research and faculty positions.

### 1.1. Background and Rationale

#### The Leaky Pipeline

The idea that students, both male and female, leave fields at various points in their lives has been termed by researchers as the “leaky pipeline”. Leaks in the pipeline are generally conceptualized in three ways: (1) students who express interest in a certain field but select other majors in college, (2) those who change majors during college, and (3) those who finish with a degree but go into other areas of study. While the leaky pipeline appears to be an issue in many fields of study, the phenomenon is especially apparent in STEM (science, technology, engineering, and mathematics) fields (Madill et al. 2007). It

may also be argued that the leaks do not stop there. The fact that gender differences exist in academia and research positions, especially in STEM fields, could be an extension of the way we traditionally think about the leaky pipeline (Blickenstaff, 2005). This issue is important in the current context because women appear to “leak” out more than men.

This disproportionate leaking of women occurs at every stage of the “academic ladder” (Moyer, Salovey, & Casey-Cannon, 1999, p. 607). For instance, in science and engineering fields, women comprise roughly 50% of those obtaining bachelor’s degrees, 45% of those obtaining master’s degrees, and only 38% of those obtaining doctoral degrees (National Science Foundation, 2008). Similar patterns are also found in math with roughly half of the bachelor’s degrees being awarded to women, but only 26% of doctoral degrees (National Center for Education Statistics, 2009). Of these women who do earn doctoral degrees, the numbers continue to decline in the progression from assistant to full professors. The further up the pipeline we look, the fewer women we see still present. According to Blickenstaff (2005), this is not a newly identified problem. In fact, the author notes that graduate programs have been encouraging increases in women in such fields for over twenty years. One of the main concerns is that the number of women working in these fields is not representative of either the population or of the number of women with degrees in them. Furthermore, such a lack of diversity limits the variety of viewpoints in academics.

While many researchers make reference to an academic pipeline, Dean and Fleckenstein (2007) argue that the way it is discussed is often too simplistic. There is not one entry and exit from the pipeline. Instead, there are many factors that influence whether or not ‘leaks’ occur and when they occur. In their model, they purport that there are many entry and branch points, and the actual process is not as linear as is implied by the analogy. This argument suggests that career goals are not stable, but instead are modified to accommodate various factors that women encounter and often have to balance in their lives. For example, available resources such as people and information to aid in career planning, the acquisition of strategies and skills gained through professional activities, and experiences in school and work can have both positive and negative effects on issues related to career commitment, choice, and decisions (Madill et al., 2007).

Similar sentiment is echoed by Etzkowitz and colleagues who argue that simple encouragement of women into academic and research positions has not been a sufficient fix to the lack of them present in these positions (Etzkowitz, Kemelgor, Neuschatz, Uzzi, & Alonzo, 1994). Therefore, not only is it important to understand the decision making process, it is equally important to identify possible contributors to the issue of the leaky pipeline. Stated simply, what is stopping women from pursuing STEM degrees in academia and careers in research? The current study will investigate the extent to which both internal and external forces predict both undergraduate and graduate students' well-being and career intentions. Specifically, using Ashburn-Nardo and Williams' (2009) model as a guide, the role that belonging uncertainty and psychological capital may have in explaining the leaky pipeline will be examined (see Figure 1).

## 1.2. Previous Theory and Research

### Ashburn-Nardo and Williams' (2009) Model

According to Ashburn-Nardo and Williams (2009), in male dominated environments (such as STEM) women tend to have greater experiences with everyday prejudice (i.e., prejudices, often subtle, that we experience in everyday life) and discrimination (e.g., Inzlicht & Ben-Zeev, 2000; Inzlicht, Aronson, Good, & McKay, 2005). Male dominated environments can include environments where women are outnumbered and/or there are stereotypic expectations and rules that favor men. Experiences with prejudice and discrimination can have detrimental effects on the psychological well-being and career outcomes of these individuals through their effect on trust, engagement, and feelings of belonging uncertainty. However, they suggest that the degree to which individuals experience negative outcomes depends on sensitivity to experiences with prejudice, or stigma sensitivity. Some people are more sensitive to or vigilant for instances of prejudice and their stigmatized status (Brown & Pinel, 2003; Cohen & Garcia, 2008; Mendoza-Denton, Page-Gould, & Pietrzak, 2006; Pinel 2004). The higher people are in stigma sensitivity, the greater their expectations are of experiencing negative events. Thus, such people may look to cues in their environment that confirm the expectations, or react more strongly when faced with negative events,

perhaps further reducing trust and engagement, and increasing feelings of belonging uncertainty (also see Johnson, Ashburn-Nardo, Spicer, & Dovidio, 2008). While stigma sensitivity serves to enhance the negative effects of prejudice on important personal and professional outcomes, the degree to which an individual has social support may serve to buffer the consequences that a low sense of belonging, low levels of trust, and low engagement have on academic and career outcomes such as psychological well-being. For example, recent research has found that both mentoring and cross-group friendships are two forms of social support that help to reduce the detrimental effects of prejudice (Mendoza-Denton et al., 2006).

### Outcomes in the Model: Symptoms of the Leaky Pipeline

Psychological well-being and career outcomes, the outcomes in Ashburn-Nardo and Williams' (2009) model, are two variables that may drastically influence many aspects of an individual's life. Further, they are of great importance to the current study in that they are factors that may contribute to leaks in the pipeline in STEM fields.

### Psychological Well-Being

Within the work literature, psychological well-being is often described as the "overall effectiveness of an individual's psychological functioning" (e.g., Wright & Bonett, 2007, p. 143; Wright & Cropanzano, 2000, p. 85). According to Wright and Bonett (2007), literature defining psychological well-being produces three common themes. First, psychological well-being is an individual perception; the degree to which a person has high levels of psychological well-being versus low levels of psychological well-being depends on the subjective judgments of that individual. Second, people with high levels of psychological well-being tend to have more positive emotions relative to negative ones. Lastly, psychological well-being is a broad construct; it is not tied to one particular domain (e.g., work, school), but instead is more comprehensive in nature and encompasses life in general.

Much literature has established the relationship between employee well-being and important work outcomes like performance and turnover. For example, Wright and Cropanzano (2000) found that employee well-being accounted for a significant amount of

variance in job performance ratings, even after controlling for age, gender, job tenure, and composite job satisfaction. Another recent study found that employees were most likely to turnover when their job satisfaction and psychological well-being were low (Wright and Bonnet, 2007). That is, when job satisfaction was low, employees with high levels of psychological well-being were less likely to turnover than those who were low in psychological well-being. Results such as these suggest that well-being may factor into employee achievement and career choices/opportunities.

### Career Outcomes

Career outcomes can be conceptualized in many different ways ranging from more objective measures like salary to subjective measures of career success like promotion or tenure. Because the current study seeks to investigate how the academic STEM environment influences the leaky pipeline for women, we will be using female students with STEM majors as our sample. Thus, of particular interest are the affective evaluations and goals held by these individuals that lead to academic and professional decisions and outcomes. For this reason, academic and career outcomes will be conceptualized by academic engagement and career intentions.

### Engagement

Engagement is defined as “...a positive, fulfilling, work-related state of mind” (Schaufeli, Salanova, González-Romá, & Bakker 2001, p. 74). Engaged employees have an affective connection with their work, and thus identify with it. This connection has a motivational/energy component that allows employees to deal effectively with the demands of their career. When conceptualized in this way, the construct of engagement is opposite in nature to the construct of burnout or emotional exhaustion. In fact, it is related to a variety of health constructs including depressive symptoms, sleep disruption, and symptoms of depression (Hallberg & Schaufeli, 2006). Engaged employees/students are (1) dedicated, (2) display vigor at work/school, and (3) are absorbed in their job/studies (Schaufeli et al., 2001).

In addition to important personal and health outcomes, research has shown that, like psychological well-being, engagement is related to important career outcomes like

job performance and job satisfaction (Bakker & Bal, 2010). One possible reason for this is that those who are more engaged are thought to create their own resources. In fact, a recent study found there to be a reciprocal relationship between job resources (e.g., professional development opportunities), personal resources (e.g., social support), and engagement (Xanthopoulou, Bakker, Demerouti, & Schaufeli, 2009). These relationships suggest that this construct may be important for understanding who decides to stay and/or advance in or leave academia. That is, the personal and professional resources generated as a result of high levels of engagement may help to facilitate advancement through the pipeline.

#### Antecedents in the Model: Factors that May Contribute to the Leaky Pipeline

The conditions present in our environment work to shape the climate of our environment. These factors include people (including role models and similar others), experiences, policies, practices, and procedures (Settles, Cortina, Stewart, & Malley, 2007). A climate is said to be ‘chilly’ when individuals within an environment are not treated equally or fairly. Even subtle differences can work to shape the climate of an environment. According to Settles and colleagues (2007), individual perception of climate is an important factor in understanding individual outcomes. It is perceptions of climate, the authors argue, that influence how people respond to it.

STEM fields in particular are consistently discussed as domains in which a chilly climate exists for women. One possible reason for this perception may be that science has traditionally been a male-dominated field (Steele, Reisz, Williams, & Kawakami, 2007). Furthermore, there is also the widely held perception that women are not as good in math and science (Eccles, Jacobs, & Harold, 1990; Swim, 1994). Consequently, the stereotypes we hold may be what are creating the chilly climate in STEM fields. Interestingly, these gender stereotypes have proven to be quite consistent and uniformly held across both genders (Heilman, 2001; Nosek, Banaji, & Greenwald, 2002). Research even suggests that these stereotypes are transferrable. In other words, a climate can serve to influence individual beliefs. For example, girls may hear such gender stereotypes and develop similar self-expectations for success (Steele et al., 2007). The ‘chilliness’ created by an

environment that appears to devalue women's contributions may result in fewer women choosing to pursue careers in and identify with STEM domains.

For those who have already begun to pursue careers in STEM areas, a chilly climate influences the *kinds* of careers that are pursued. In fact, in a recent survey of over 8,000 male and female doctoral students, negative experiences as a PhD student (46% of women, 44% of men), and feelings of isolation or alienation as a PhD student (35% of women, 31% of men) were commonly reported as reasons for moving career goals away from that of a professor with a research emphasis (Mason et al., 2009). While these experiences are reported across genders, it may be that the *causes* of such feelings and experiences may differ. For women, these negative experiences and feelings of isolation may stem from incompatibility between STEM culture and their identity as a woman.

Social psychologists suggest that people hold multiple social identities (e.g., the identity of a woman, the identity of a parent, the identity of a science major). One's social group serves as a referent group that people identify with and thus, define themselves by. These "self definitions" serve as the basis for in-group and out-group comparisons and influence when one might feel they do or do not fit in (Hogg, Terry, & White, 1995, p. 259). One consequence of these comparisons is that people tend to pay more attention to aspects of themselves that *do not* fit with their environment (Hogg, Terry, & White, 1995). Additionally, people who identify with stigmatized groups are especially sensitive to issues of belonging that can be signaled by such comparisons. Identity threat occurs when an identity is engaged and perceived to be of possible negative evaluation (Cohen & Garcia, 2008). Because negative evaluations can threaten a group's sense of belonging, especially when the group is of minority status in the environment, individuals who experience identity threat may also experience belonging uncertainty. In the current study, we will use the Ashburn-Nardo and Williams (2009) model to investigate the role that belonging uncertainty has in contributing to the leaky pipeline.

### Sense of Belonging

Belonging uncertainty is defined as "a global concern about the quality of one's social ties" (Walton & Cohen, 2007, p. 83). People who experience belonging uncertainty may be concerned that they do not fit in their current environment, they may feel like they do

not have strong social connections, and/or they may experience doubt as to whether or not they will be accepted by others (Walton & Cohen, 2007; Cohen & Garcia, 2008). Walton and Cohen (2007) suggest that minority group members are especially susceptible to feelings of belonging uncertainty in achievement-based areas, including school and work.

Belonging uncertainty can be triggered by a variety of environmental factors/events; the only requirement is that the event causes the individual to question their social ties (Walton & Cohen, 2007). Thus, feelings of belonging uncertainty can be triggered even when the person perceiving the stereotypical suggestion is not targeted by it. In fact, research suggests individual perceptions of discrimination do not need to be convergent with the perceptions of others to be harmful (e.g., Adams Garcia, Purdie-Vaughns & Steele, 2006; Cohen & Garcia, 2008; Settles, Cortina, Stewart, & Malley, 2007). Furthermore, results of Walton & Cohen's (2007) study investigating belonging uncertainty suggests that feelings of belonging uncertainty arise even in situations where there is no concern of being stereotyped, no fear of negative feedback, and no test administered. In their study, Black and White undergraduate students were asked to generate a list of either eight friends, two friends, or no friends that would fit in well in the computer science department. Then, they were asked about their sense of fit within the department. While all participants reported difficulty in generating eight friends, only minority students reported a lesser sense of fit after the task of generating friends. This simple task was enough to cause minority students to question whether or not they belonged in the computer science major. Results such as these highlight the broad nature of the construct; even subtle cues have the potential to induce belonging uncertainty.

Findings similar to those found in Walton and Cohen's (2007) study may extend to women in STEM fields. According to Adams and colleagues (2006), a lifetime of exposure to climates where women are outnumbered or are stigmatized may shape women to be more aware or vigilant to the possibility of experiencing negative events (Adams et al., 2006). The identity engagement model, based on Social Identity Theory, suggests that if people feel their identity is one of a negative stereotype (and thus experience identity threat or belonging uncertainty), their identity is more likely to be engaged, and if situational cues confirm a threat to it, they are more likely to

underperform (Cohen & Garcia, 2008). The differences in the way people perceive threats in their environments can influence the degree of negative effects that are experienced. If negative events are experienced, individuals may engage in identity adaptations or protective reactions. These reactions may include domain avoidance, self-handicapping, counter stereotypical behavior, disengagement, and/or the more long term strategy of disidentification (Steele, Spencer, & Aronson 2002). Research also suggests that a person's sense of belonging is related to, among other things, their self-efficacy and cognitive engagement, two important factors influencing career outcomes (Walker & Greene, 2009). Sense of belonging even influences the type of approach students take in learning. Among a sample of high school students, belonging predicted an additional 5% of the variance in whether or not students adopted a mastery orientation learning approach (e.g. learning for understanding and comprehension) over both self-efficacy and perceived instrumentality (Walker & Greene, 2009).

Consequently, the reactions and decisions described above may generate or contribute to leaks in the pipeline of STEM fields. However, while experiencing belonging uncertainty is psychologically harmful, individual difference factors may influence the harm experienced. Psychological capital (PsyCap) is one such factor that may influence the relationship between experienced discrimination and career outcomes, and experienced discrimination and well-being.

### Psychological Capital (PsyCap)

Psychological capital is a higher order construct emerging from the positive psychology literature (Avey, Luthans, Smith, & Palmer 2010). It refers to “an individual's positive psychological state of development that is characterized by: (1) having confidence (self-efficacy) to take on and put in the necessary effort to succeed at challenging tasks; (2) making a positive attribution (optimism) about succeeding now and in the future; (3) persevering towards goals and, when necessary, redirecting paths to goals (hope) in order to succeed; and (4) when beset by problems and adversity, sustaining and bouncing back and even beyond (resilience) to attain success” (Luthans, Avolio, Avey & Norman, 2007, p. 3). Recent research has supported the utility of PsyCap as a higher order construct in predicting important work outcomes like satisfaction and performance. Specifically,

results of a usefulness analysis suggest that, in general, PsyCap is more related to satisfaction and performance than each of the individual components alone (Luthans et al., 2007).

PsyCap is thought to be a malleable construct that can be both strengthened and weakened. The idea that PsyCap is a relatively enduring construct but is also developable makes it plausible to investigate as both a mediator and moderator of the relationship between belonging uncertainty, career outcomes, and psychological well-being. The current study seeks to investigate how psychological capital fits into the Ashburn-Nardo and Williams (2009) model.

Research has established the relationship between PsyCap and important work outcomes including organizational commitment, job satisfaction, and what is of interest in the proposed study, psychological well-being (e.g., Avey et al., 2010; Luthans et al., 2007). The proposed study suggests that sense of belonging affects a person's psychological well-being through its relationship with PsyCap. As so, it may serve as a mediator in the Ashburn-Nardo and Williams (2009) model (see Figure 2). For example, research has suggested that an individual's level of PsyCap mediates the relationship between a supportive climate and performance (Luthans, Norman, Avolio, & Avey, 2008). That is, the researchers found evidence within the work environment that a supportive climate (defined as a perception of the amount of support from those around including peers and supervisors) creates the conditions necessary to build psychological capital, which in turn positively impacts performance. These findings may also be able to generalize into the academic environment. For example, experiencing high levels of belonging uncertainty may reduce PsyCap, and in turn, psychological well-being. To our knowledge, no current studies have directly investigated the relationship between PsyCap and career outcomes such as engagement, and PsyCap and belonging uncertainty. Therefore, the proposed study will attempt to establish these links.

However, some research also suggests that the relationship between sense of belonging and psychological well-being could be moderated by PsyCap (see Figures 3-4). We suggest that low levels of PsyCap could serve to emphasize the negative effects of discrimination on career outcomes. That is, the relationship between belonging uncertainty and career outcomes is expected to be stronger among those who also report

low levels of PsyCap. Conversely, when PsyCap is higher, this relationship will be weaker. A similar relationship could be expected between sense of belonging, PsyCap, and psychological well-being. Feelings of belonging uncertainty may be especially harmful to well-being when PsyCap is also low.

Findings from recent research may support this relationship. For example, a recent dissertation found that high levels of optimism, one component of PsyCap, buffered the negative psychological effects of discrimination (Little, 2007). By some definitions, optimistic people tend to internalize positive events, but make external attributions to negative events (Luthans et al., 2007). To the extent that negative experiences are attributed to external events, a person's well-being is less harmed. Another study investigated the role that cognitive hardiness (a characteristic of people thought to be resilient, another component of PsyCap) plays in the stress-health relationships (Beasley, Thompson, & Davidson, 2003). Their findings suggest that, for women, cognitive hardiness buffers the stress caused by negative life events on health. Individuals who are resilient are better able to bounce back from adverse events. When faced with challenges or negative environments (such as those that may be experienced in STEM fields), these individuals are able to work through the difficulty in a more proactive way.

Based on the research outlined above, along with research suggesting both the stability and malleability of PsyCap, it seemed likely that PsyCap exerts influence over the relationship between sense of belonging and career outcomes. However, based on current supporting literature, it was difficult to determine the exact role it plays in the Ashburn-Nardo and Williams (2009) model. Thus, we sought to examine PsyCap as both a mediator and a moderator of the relationships between sense of belonging and psychological well-being and academic/career outcomes.

### 1.3. Present Study

The underrepresentation of women in research and academia is a complicated matter. It is our intent that this study offer insight into the different factors that relate to academic and career choice. More specifically, it seeks to answer the question: how do sense of belonging and PsyCap influence the academic and professional outcomes of

students in terms of career intentions and psychological well-being? According to Madill et al. (2007), career expectations held upon entering college are usually not met by the actual experience. In their study, those who came to college with a clear idea of what they wanted to do (often medicine) came across obstacles that forced them to rethink career goals. Based on the previously outlined research, and using Ashburn-Nardo and Williams' (2009) model as a guide, we predicted the following relationships:

Hypothesis 1a: The relationship between sense of belonging and career outcomes will be partially mediated by the level of a person's PsyCap such that a low sense of belonging/belonging uncertainty will lead to subsequent decreases in PsyCap. Low levels of PsyCap, in turn will result in greater intentions to leave STEM, lower levels of engagement, and lower GPA.

Hypothesis 1b: The relationship between sense of belonging and psychological well-being will be partially mediated by the level of a person's PsyCap such that a low sense of belonging/belonging uncertainty will lead to subsequent decreases in PsyCap. Low levels of PsyCap, in turn will result in lower levels of psychological well-being.

Hypothesis 2a: The relationship between sense of belonging and career outcomes will be moderated by the level of a person's PsyCap. Specifically, the positive relationship between sense of belonging and career outcomes will be stronger for those with higher PsyCap than for individuals with lower PsyCap.

Hypothesis 2b: The relationship between sense of belonging and psychological well-being will be moderated by the level of a person's PsyCap. Specifically, the positive relationship between sense of belonging and psychological well-being will be stronger for those with higher PsyCap than for individuals with lower PsyCap.

## CHAPTER 2. METHOD

### 2.1. Participants

Participants were recruited and sampled from the female STEM student population of Indiana University – Purdue University Indianapolis at two times during the fall semester. The sample consisted of 182 female undergraduate STEM majors at time one and 86 female undergraduate STEM majors at time two. All participants were at least 18 years old at the time of the study. Students were recruited via emails sent to their university email accounts, and those individuals who participated in the study had their names entered into a drawing for one of four \$25 Target gift cards.

Participants at time one were 21.92 years old on average and 1.6% reported being Hispanic or Latina, 89.6% reported not being Hispanic or Latina, and 8.7% did not report an ethnicity. Of those who reported being not Hispanic or Latina, 77.6% were White, 6.6% were Black, 4.4% were Asian, and 10.3% did not report their race. Respondents were from various areas of STEM including biology (16.9%), chemistry (7.1%), computer science (1.1%), engineering (15.8%), environmental science (1.1%), forensic and investigative science (5.5%), geology (.5%), math (6%), and psychology (33.9%). These numbers closely mirror the true representation of women in each STEM major in the School of Science population at IUPUI (e.g., women with forensic and investigative science majors represent 4.5% of the women in STEM majors at IUPUI, female math majors represent 4.2%, female computer science majors represent 1.8%, and female psychology majors represent 36.8%; Information Management and Institutional Research, 2010). At the time of the study, participants had taken an average of 8.31 courses in their majors and 21.65 courses total with an average GPA of 3.37 on a 4.0 scale. Additionally, 15.3% were freshmen, 24% were sophomores, 16.4% were juniors, and 35.5% were seniors.

Participants at time two were 22.57 years old on average and 2.6% reported being Hispanic or Latina, 97.4% reported not being Hispanic or Latina, and 9.3% did not report an ethnicity. Of those who reported being not Hispanic or Latina, 75.6% were White,

3.5% were Black, 4.7% were Asian, 1.2% were Native Hawaiian or other Pacific Islander, and 15.1% did not report a race. Respondents at time two represented STEM in areas of biology (3.5%), chemistry (4.7%), engineering (32.6%), and psychology (48.8%). At the time of the study, participants had taken an average of 8.69 courses in their majors and 25.03 courses total with an average GPA of 3.37 on a 4.0 scale. Additionally, 20.5% were freshmen, 19.2% were sophomores, 23.1% were juniors, and 37.2% were seniors.

Twenty-seven participants responded at both time one and time two and represented STEM areas of biology (7.4%), engineering (40.7%), and psychology (44.4%). Participants were 23.74 years of age on average, and all were White. At the time of the study, participants had taken an average of 8.23 courses in their majors and 26.45 courses total with an average GPA of 3.39 on a 4.0 scale. Finally, 14.8% were freshmen, 11.1% were sophomores, 18.5% were juniors, and 51.9% were seniors.

## 2.2. Design

In the present study, a correlational design was used and no variables were manipulated. We collected responses from participants on all of the investigated variables at two times during the fall semester, once near the start of the semester and once near the end of the semester. This allowed us to examine the stability of the constructs across time.

## 2.3. Measures

### Demographic Items

Participants were asked to provide demographic information including: (1) age, (2) ethnicity, (3) race, (4) level in school (i.e., freshmen, sophomore, junior, senior), (5) number of courses taken so far in their major, (6) number of courses taken so far total, (7) major/field of study, and (8) grade point average (GPA). Participants were also asked to provide the name of the street they grew up on and the name of their favorite teacher in order to allow us to link their responses at time two to their responses at time one without having to use identifying information.

### Psychological Capital (PsyCap)

PsyCap was measured using the PCQ-24 (for validity analyses, see Luthans, Avolio, & Youseff, 2007). Each of the four subscales (i.e., hope, optimism, resilience, and self-efficacy) is comprised of six items measured on a six-point Likert-type response format. Research suggests that the combination of these factors/subscales have greater predictive power than each scale individually (e.g., Luthans, Avolio, Avey, & Norman, 2007). Thus, items were collapsed into one composite factor, with higher scores indicating higher levels of PsyCap. All items of the PCQ measure were aligned with the concept of academics (Appendix B). Therefore, more academically aligned words including “coursework,” “academic,” and “school” replaced the word “work” in the original PCQ. An example item from each of the subscales on the questionnaire include “At the present time, I am energetically pursuing my *academic* goals,” (*hope*), “When things are uncertain for me in my *coursework*, I usually expect the best,” (*optimism*), “When I have a setback in my *coursework*, I usually have trouble recovering from it, moving on,” (*resilience*), and “I feel confident contributing to discussions in my *major courses*” (*self-efficacy*). Coefficient alpha for the overall scale was .92 at time one and .95 at time two. An exploratory factor analysis confirmed the four-factor structure of the construct. Specifically, we used principal axis factoring with oblimin rotation. The initial analysis pulled out five factors, and we also examined the structure after pushing the analysis to four factors as conceptualized. While there was some cross loading, in general, items were loading onto the appropriate factors. Thus, we deemed it appropriate to use.

### Sense of Belonging

Sense of belonging was measured using Walton and Cohen’s (2005) measure of social fit. The social fit scale is composed of 17 items and is measured using a seven-point Likert-type response format ranging from “strongly disagree” to “strongly agree”. Because belonging to STEM is what is of interest to the current study, items were framed so that the questions refer to the participant’s program or major (Appendix B). Example items include: “People in my *major* accept me” and “I think in the same way as people who do well in my *major*”. Items were measured as one total score with higher scores

indicating a higher sense of belonging. Coefficient alpha for the scale was acceptable at both times,  $\alpha=.91$  at time one and  $\alpha=.94$  at time two.

### Psychological Well-Being

Avey, Luthans, Smith and Palmer (2010) suggest that psychological well-being is best construed as having both cognitive and affective components. Following this logic, psychological well-being was measured using (1) Watson, Clark, and Tellegen's (1988) Positive and Negative Affect Schedule (PANAS), (2) Goldberg's (1972) 12-item General Health Questionnaire (GHQ), and (3) Deiner and colleagues (1985) Satisfaction with Life (SWL) Scale. The PANAS scale is measured using a five-point Likert-type response format and may tap into more affective components of well-being (Appendix B). Response options range from "very slightly or not at all" to "extremely". Items ask participants to indicate, *in general*, how often they feel in each of the ways listed. Items include both negative (e.g., irritable) and positive feelings (e.g., interested).

The GHQ and SWL questions, on the other hand, may tap into more cognitive components of well-being (Avey et al., 2010). The questions for the GHQ require participants to indicate how they feel about 12 statements (experiences/symptoms) based on four response options ranging from "much less than usual" to "better than usual" (Appendix B). The 12-item measure was adapted from the original 60-item questionnaire. An example item from the questionnaire is "Have you recently felt that you couldn't overcome your difficulties?" The SWL Scale consists of five items measured on a seven-point Likert-type response format (Appendix B). Participants were asked to indicate their agreement with the five items with response options ranging from "Strongly Disagree" to "Strongly Agree". Items were measured as one total score with higher scores indicating greater SWL. An example item from this scale includes, "In most ways my life is close to ideal".

Coefficient alpha for the GHQ was acceptable,  $\alpha=.84$ , at time one, and dropped at time two,  $\alpha=.77$ . This may reflect our smaller sample at time two with less variability. Coefficient alpha for the SWL Scale, however was acceptable at both times, .92 at time one and .91 at time two. Finally, coefficient alpha for the PANAS were acceptable at both

times,  $\alpha=.89$  at time one and  $\alpha=.92$  at time two for questions measuring positive affect, and  $\alpha=.87$  at time one and  $\alpha=.89$  at time two for the items measuring negative affect.

## Career Outcomes

### Engagement

Schaufeli, Salanova, González-Romá, and Bakker (2001)'s Engagement Scale was used to measure student engagement (note: there is also a work engagement version). Engagement is measured by three factors including vigor, dedication, and absorption (Appendix B), but was examined as one composite measure with higher scores indicating higher engagement. The subscale of *vigor* is measured by six items including "I can continue studying for very long periods at a time." The second subscale, *dedication* is measured by five items. Items comprising this scale include "I find my studies full of meaning and purpose." Lastly, the subscale of *absorption* is comprised of six items. A sample item from this subscale includes "I get carried away when I am studying." For the measure overall, coefficient alpha was .91 at time one and .93 at time two. We performed an exploratory factor analysis and confirmed the three-factor structure of the construct. We used principal axis factoring with oblimin rotation. The initial analysis pulled out four factors, and we also examined the structure after pushing the analysis to three factors as conceptualized. While there was some cross loading, in general, items were loading onto the appropriate factors. Thus, we deemed it appropriate to use.

### Career Intentions

Career intention items measured student intentions in three areas including: (1) intentions to stay and complete their degree, (2) intentions to pursue/continue graduate training, and (3) intentions to enter into research/academics (Appendix B). In total, there were six statements of career intentions (two items measuring each of the three areas addressed above). Responses were measured on a seven-point Likert-type response format with options ranging from "Strongly Disagree" to "Strongly Agree". Responses to each item were analyzed individually (i.e., we did not combine the intention statements into a composite score).

#### 2.4. Procedure

Participants were recruited via email at two times during the semester. Emails were sent out to female undergraduate STEM students' university email accounts with an embedded link directing them to Survey Monkey, an online survey database if they chose to participate in the study. Those who participated in the study could enter their names into a lottery for a chance to win one of four \$25 Target gift cards as compensation. The first email was sent out at the start of the fall semester and the second email was sent out three quarters of the way through the semester. All variables were measured at both times during the semester to allow us to track any changes that occurred, thus participants completed the same measures at both time one and time two. Participants who completed the survey at both times had their name entered into the lottery twice.

#### 2.5. Statistical Analyses

All hypotheses were tested for statistical significance using two-tailed tests at the alpha level of  $p < .05$ . Results were considered to approach significance if the test for significance was at or below the .10 level but greater than or equal to .05. Exact  $p$ -values were reported for all cases, except those less than .001; for those exceptions,  $p < .001$  was reported. Next, the means, standard deviations, and intercorrelations were calculated for variables at each time (Tables 1-3).

We tested Hypotheses 1a and 1b for mediation using hierarchical linear regression and by constructing asymmetric 95% confidence intervals of the indirect effects as suggested by MacKinnon and Fairchild (2009). Traditionally, researchers have analyzed mediated effects by conducting multiple regression equations using the methodology suggested by Baron and Kenny (1986) and testing the significance of the indirect effect using the Sobel Test, a test of significance that assumes normality (Sobel, 1982). However, researchers have recently argued this approach may be too conservative and could result in an underestimate of the mediated effect. Researchers now suggest that calculating the indirect effect ( $ab$ ) and testing it for significance is a superior method to traditional significance testing (e.g., Hayes, 2009; MacKinnon & Fairchild, 2009; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002; Preacher & Hayes 2004; see Figure 4). This method does not require the initial variable,  $X$ , to have an effect on the

outcome,  $Y$  ( $c$ ). Furthermore, no assumptions are made about the shape of the sampling distribution or the variables, an assumption that often leads to inaccuracies and type II errors (MacKinnon et al., 2002, Preacher & Hayes, 2004). Thus, bootstrapping is more sensitive to detect effects that are present (Hayes, 2009).

Using the methodology suggested by MacKinnon and Fairchild (2009), the goal was to determine whether PsyCap ( $b$ ) mediated the relationship between sense of belonging ( $a$ ) and important career and psychological outcomes ( $c$ ), respectively (Figure 4). The unstandardized regression coefficients for  $a$  and  $b$ , their respective standard errors, the correlation between  $a$  and  $b$ , and the alpha level were entered into Proclin, a downloadable program we used to construct these confidence intervals (MacKinnon, Fritz, Williams, & Lockwood, 2007). A mediated effect is said to exist if the confidence intervals constructed for the indirect effect do not contain zero.

Hypotheses 2a and 2b were assessed using hierarchical linear regression. These hypotheses sought to determine whether or not there was an interaction between sense of belonging and PsyCap in relation to important academic/career and psychological well-being outcomes, such that high levels of PsyCap would buffer the negative effects of low sense of belonging or high levels of belonging uncertainty. First, the two independent variables (i.e., sense of belonging, PsyCap) were mean-centered and an interaction term was created from the product of the two centered independent variables. In step one, the two centered predictors were entered, and then in step two, the interaction term was entered. To determine if the interaction was significant, the second step of the regression was examined for a statistically significant increase in the total variance explained.

For each of the significant interactions, slope analyses were conducted to determine whether or not there were significant differences between high and low levels each of the predictors using procedures outlined by Aiken and West (1991). First, we computed high and low values of each of the continuous predictors by adding (for low) and subtracting (for high) one standard deviation from the mean. Finally, four separate regression analyses were run to determine (a) the effect of belonging at (1) high and (2) low levels of PsyCap, and (b) looking at the effect of PsyCap at (3) high and (4) low levels of belonging).

## CHAPTER 3. RESULTS

### 3.1. Preliminary Analyses

Psychology majors represented the largest group of students in our sample. Because psychology is not typically housed in a school of science, it is not always considered to be a STEM discipline. One possible implication of this is that these individuals may not have the same experiences as traditional STEM majors. In order to determine whether or not psychology majors were significantly different than other STEM majors, independent samples t-tests were run for all of the outcome variables. Results suggested that there were no significant differences between psychology and other STEM majors on all outcome variables with the exception of SWL. That is, psychology majors reported significantly lower levels of SWL than other STEM majors ( $t(157)=2.42, p=.015$ ). Because this group only differed on one of the outcome variables, we determined it appropriate to analyze our hypotheses with psychology majors included.

As previously indicated, data were collected from participants at two times during the semester. Intercorrelations, means, and standard deviations for time one data are presented in Table 1 for time one data and in Table 2 for time two data. Of the participants who participated in the study, only 27 participants participated at both time one and time two (Table 3 shows the relationships between the variables at time one and time two). Using only these individuals to longitudinally test our hypotheses would significantly limit our power to detect effects. Therefore, hypotheses will be tested using time one data only. However, the longitudinal relationships will still be examined (see further analyses for details).

### 3.2. Hypotheses Tests

#### Hypotheses 1a-1b

Hypotheses 1a and 1b predicted that PsyCap would mediate the relationship between sense of belonging and academic and career outcomes and psychological well-being.

#### Hypothesis 1a

Hypothesis 1a predicted that the relationship between sense of belonging and academic and career outcomes would be mediated by PsyCap. That is, sense of belonging was expected to influence academic and career outcomes through PsyCap. This hypothesis was tested using linear hierarchical regression. First, we determined the correlation between sense of belonging and the outcome variables and the correlation between sense of belonging and PsyCap. Next, we ran a hierarchical regression with sense of belonging entered in step one and PsyCap entered in step two of the regression to determine the effect of the mediator. Lastly, confidence intervals were created around the mediated effect to test it for significance using Prodclin (MacKinnon et al., 2007). The relationship between the independent variable and the mediator was supported as sense of belonging was significantly related to PsyCap ( $r=.65, p<.001$ ). To avoid redundancy, this relationship will not be further discussed in the description of the mediation results.

#### Engagement

Table 4 indicates the results of the regression analysis. Sense of belonging significantly predicted engagement ( $\beta=.53, p<.001$ ). In the second step of the regression, the beta weight for sense of belonging dropped but remained significant in the presence of PsyCap ( $\beta=.31, p<.001$ ), and PsyCap significantly predicted engagement ( $\beta=.34, p<.001$ ). Results of the significance test of the indirect effect suggest that there is significant mediation at the 95% confidence level (.114 to .343).

### Intentions to Complete Major

Sense of belonging and intentions to complete major were significantly related ( $\beta=.32, p<.001$ ; Table 4). PsyCap did not predict intentions to complete major when sense of belonging was included in the model ( $\beta=.03, p=.767$ ). Furthermore, the relationship between sense of belonging and intentions to complete major remained significant at step two of the regression ( $\beta=.30, p=.003$ ) and the confidence interval constructed contained zero (-.148 to .202). Therefore, mediation did not occur.

### Intentions to Switch Major

Sense of belonging and intentions to switch majors were significantly related ( $\beta=-.37, p<.001$ ; see Table 4). However, PsyCap did not significantly predict intentions to switch majors when controlling for sense of belonging ( $\beta=.06, p=.546$ ), and the beta weight for sense of belonging remained significant in step two of the regression ( $\beta=-.41, p<.001$ ). Results of the significance test indicate that mediation did not occur as the confidence interval contained zero (-.155 to .297).

### Intentions to Apply to Graduate Programs in the Same Major or a Related Major

Sense of belonging and participant intentions to apply to graduate programs in the same or a related major were significantly related ( $\beta=.19, p=.017$ ). However, PsyCap was not significantly related to intentions to complete major ( $\beta=.09, p=.353$ ) and sense of belonging was not significantly related to intentions to apply to graduate programs in the same major or a related one at step two of the regression ( $\beta=.12, p=.224$ ; Table 4). Results of the significance test indicate that mediation did not occur (-.148 to .425).

### Intentions to Apply to Graduate Programs in an Area Unrelated to Their Current Major

As indicated in Table 4, sense of belonging was not significantly related to intentions to apply to graduate programs in an unrelated area ( $\beta=-.08, p=.304$ ). However, at step two of the regression, sense of belonging was significantly related to the intention ( $\beta=-.24, p=.018$ ), and PsyCap was significantly related to the intention when controlling for sense of belonging ( $\beta=.25, p=.016$ ). Results of the significance test suggest that mediation did in fact occur as the confidence interval constructed did not contain zero

(.071 to .653). Specifically, these patterns suggest a suppressed mediated effect. That is, when the mediator, PsyCap, is entered into the equation, it cleans up ‘noise’ that clouds the zero-order relationship between sense of belonging and participant intentions to apply to graduate programs in an area unrelated their current major.

#### Intentions to Seek a Job Where Research is a Major Focus

The relationship between sense of belonging and intentions to seek a job where research is a major focus was only marginally significant ( $\beta=.15, p=.061$ ), but PsyCap and participant intentions to seek a job where research was a major focus were not significantly related when controlling for sense of belonging ( $\beta=.08, p=.45$ ), and the confidence interval created did contain zero (-.17 to .39; see Table 4). Thus, mediation did not occur.

#### Intentions to Seek a Job in a Clinical or Applied Setting

The relationship between sense of belonging and intentions to seek a job in a clinical or applied setting was significant, ( $\beta=.16, p=.038$ ). However, PsyCap and participant intentions to seek a job in a clinical or applied setting were not related when controlling for sense of belonging ( $\beta=.05, p=.628$ ), and the confidence interval created contained zero (-.214 to .358; see Table 4).

#### Grade Point Average (GPA)

As indicated by Table 4, PsyCap did not mediate the relationship between sense of belonging and GPA. Sense of belonging was not related to GPA ( $\beta=.08, p=.339$ ), PsyCap was not significantly related to GPA after controlling for sense of belonging ( $\beta=.11, p=.319$ ), and the confidence intervals created contained zero (-.032 to .101).

Based on the results of the mediation analyses above, H1a was partially supported. PsyCap significantly mediated the relationship between sense of belonging and engagement and participants’ intentions to apply to a graduate program in an area unrelated to their current major. However, it did not significantly mediate the relationship sense of belonging and measures of academic and career intent (other than for intentions to apply to graduate school in an unrelated area) or GPA.

## Hypothesis 1b

### Cognitive Well-Being

Sense of belonging and GHQ were significantly related ( $\beta=.43, p<.001$ ; see Table 4). PsyCap also significantly predicted GHQ when controlling for sense of belonging ( $\beta=.29, p=.002$ ). Finally, the beta weight for sense of belonging dropped, but remained significant in the presence of PsyCap at step two of the regression ( $\beta=.24, p=.007$ ). A significance test of the indirect effect suggests that there is indeed significant mediation at the 95% confidence level (.04 to .19).

Sense of belonging significantly predicted SWL ( $\beta=.44, p<.001$ ; Table 4). In step two of the regression, the beta weight for sense of belonging dropped but remained significant ( $\beta=.25, p=.006$ ) in the presence of PsyCap. Results of the significance test suggest that there is significant mediation at the 95% confidence level (.103 to .493).

### Affective Well-Being

Sense of belonging and PA were significantly related ( $\beta=.52, p<.001$ ), and PsyCap significantly predicted PA when controlling for sense of belonging ( $\beta=.59, p<.001$ ). Lastly, the beta weight for sense of belonging dropped in the presence of PsyCap at step two in the regression ( $\beta=.14, p=.06$ ; see Table 4). Significance tests of the indirect effect suggest significant mediation at the 95% confidence level (.227 to .418).

Support for mediation was also found for NA (see Table 4). Sense of belonging and NA were significantly related ( $\beta=-.40, p<.001$ ). PsyCap significantly predicted NA when controlling for sense of belonging ( $\beta=-.31, p=.001$ ), and the beta weight for sense of belonging dropped, but remained significant in the presence of PsyCap at step two in the regression ( $\beta=-.20, p=.05$ ). Significance test of the indirect effect suggest that there is significant mediation at the 95% confidence level (-.271 to -.069).

Based on the results outlined above, Hypothesis 1b was fully supported. PsyCap significantly mediated the relationship between sense of belonging and both cognitive and affective components of well-being for women in STEM. Collectively, this pattern of results suggests that sense of belonging is more related to other subjective measures of well-being, but not to “objective” indicators of performance (e.g., GPA).

### Hypothesis 2a-2b

Hypothesis 2a and 2b predicted an interaction between sense of belonging and PsyCap in relation to important career and psychological well-being outcomes, such that high levels of PsyCap would buffer the negative effects of a low sense of belonging.

#### Hypothesis 2a

Hypothesis 2a predicted that PsyCap would moderate the relationship between sense of belonging and important career outcomes including engagement, SWL, intentions to complete or switch majors, intentions to apply to graduate school in the same field as their major or an unrelated field, intentions to pursue a career in research or to pursue a career in a clinical or applied setting, and GPA. That is, it was hypothesized that PsyCap would buffer the negative effects of a low sense of belonging on important outcomes. The results of the moderation analyses can be seen in Table 5.

#### Engagement

As indicated by Table 5, PsyCap and sense of belonging significantly predicted engagement ( $\beta=.34, p<.001$  and  $\beta=.31, p<.001$ , respectively), accounting for 35% of the variance. However, the hypothesis that PsyCap would moderate the relationship between sense of belonging and engagement was not supported as the interaction term failed to explain significant incremental variance when entered in the second step of the hierarchical regression ( $\Delta R^2=.003, p=.367$ ).

#### Intentions to Complete Major

While PsyCap did not significantly predict participant intentions to complete their major, sense of belonging did predict it ( $\beta=.03, p=.767$  and  $\beta=.30, p=.003$ , respectively), accounting for 9% of the variance in the intention. As indicated by Table 5, the hypothesis that PsyCap would moderate the relationship between sense of belonging and intentions to complete their major was not supported, however, as the interaction term failed to explain significant incremental variance when entered in the second step of the hierarchical regression ( $\Delta R^2=.003, p=.459$ ).

### Intentions to Switch Major

PsyCap did not predict participant intentions to switch majors ( $\beta=.06, p=.546$ ), but sense of belonging did significantly predict it ( $\beta=-.41, p<.001$ ). The initial model accounted for 13% of the variance in intentions to switch (see Table 5). The hypothesis that PsyCap would moderate the relationship between sense of belonging and intentions to switch majors was in fact supported as the interaction term explained significant incremental variance when entered in the second step of the hierarchical regression ( $\Delta R^2=.03, p=.01$ ; see Figure 5). The interaction occurred such that those with a higher sense of belonging and lower levels of PsyCap expressed the most negative intentions to switch majors. While no group reported positive intentions to switch majors, those with the lowest sense of belonging in their major (regardless of PsyCap) were the group reporting the greatest positive intentions ( $\beta=-.028, p=.779$ ). Those who reported a high sense of belonging and high PsyCap reported significantly greater intentions to switch majors than those with a high sense of belonging and low levels of PsyCap, but the intentions were still less than those who reported a low sense of belonging overall ( $\beta=.25, p=.041$ ). Finally, there were significant changes in participants' intentions to switch majors from low belonging to high belonging for both high and low levels of PsyCap ( $\beta=-.25, p=.032$  and  $\beta=-.52, p<.001$ , respectively).

### Intentions to Apply to Graduate Programs in the Same Major or a Related Major

Neither PsyCap nor sense of belonging significantly predicted participant intentions to apply to graduate programs in their current major or a related major ( $\beta=.09, p=.353$  and  $\beta=.12, p=.224$ , respectively). Consequently, the initial model only accounted for 3% of the variance in the intention (see Table 5). The hypothesis that PsyCap would moderate the relationship between sense of belonging and intentions to apply to graduate programs in the participant's current major or a related field was not supported as the interaction term failed to explain significant incremental variance when entered in the second step of the hierarchical regression ( $\Delta R^2 =.001, p=.739$ ).

### Intentions to Apply to Graduate Programs in an Area Unrelated to Their Current Major

PsyCap and sense of belonging significantly predicted participant intentions to apply to graduate programs in an unrelated area to their current major ( $\beta=.25, p=.016$  and  $\beta=-.24, p=.018$ , respectively). This initial model accounted for 3% of the variance in the intention. Additionally, the hypothesis that PsyCap would moderate the relationship between sense of belonging and participant intentions to apply to graduate programs in an unrelated area to their current major was supported as the interaction term explained significant incremental variance when entered in the second step of the hierarchical regression ( $\Delta R^2=.03, p=.02$ , see Table 5, Figure 6). The interaction occurred such that those who reported a low sense of belonging but a high level of PsyCap were the most likely to report intentions to apply to graduate programs in an unrelated major. These individuals were significantly more likely to express the intentions than those who reported low PsyCap ( $\beta=.33, p=.002$ ). There were no differences between individuals who reported a high sense of belonging ( $\beta=.06, p=.647$ ). Furthermore, there was a significant change in intentions from low to high belonging among those with high PsyCap, but not for those with low PsyCap ( $\beta=-.4, p=.001$  and  $\beta=-.13, p=.249$ , respectively).

### Intentions to Seek a Job Where Research is a Major Focus

As indicated by Table 5, neither PsyCap nor sense of belonging significantly predicted participant's intentions to seek a job where research is a major focus ( $\beta=.08, p=.450$  and  $\beta=.10, p=.352$ , respectively) and only accounted for 1% of the variance. Additionally, the hypothesis that PsyCap would moderate the relationship between sense of belonging and participant intentions to seek a career in research was not supported as the interaction term failed to explain significant incremental variance when entered in the second step of the hierarchical regression ( $\Delta R^2=.002, p=.581$ ).

### Intentions to Seek a Job in a Clinical or Applied Setting

Neither PsyCap nor sense of belonging significantly predicted participant intentions to seek a job in a clinical or applied setting ( $\beta=.05, p=.628$  and  $\beta=.13, p=.207$ , respectively). Furthermore, the hypothesis that PsyCap would moderate the relationship

between sense of belonging and participant intentions to seek a job in a clinical or applied setting was not supported as the interaction term failed to explain significant incremental variance when entered in the second step of the hierarchical regression ( $\Delta R^2=.018$ ,  $p=.079$ ; see Table 5, Figure 7).

#### Grade Point Average (GPA)

Neither PsyCap nor sense of belonging predicted GPA ( $\beta=.12$ ,  $p=.319$  and  $\beta=.01$ ,  $p=.913$ , respectively). This initial model did not account for any variance in GPA (adjusted  $R^2=-.001$ ). The hypothesis that PsyCap would moderate the relationship between sense of belonging and GPA was not supported as the interaction term failed to explain significant incremental variance when entered in the second step of the hierarchical regression ( $\Delta R^2=.003$ ,  $p=.515$ ; see Table 5).

These results provide limited support for Hypothesis 2a. Support was found for PsyCap as a moderator of the relationship between intentions to switch majors and intentions to apply to graduate programs in unrelated fields to their current major. However, no support was found for PsyCap as a moderator of engagement, participant intentions to complete their current major, intentions to apply to graduate programs in their current major or a related field, intentions to seek a position in research, intentions to seek a job in a clinical or applied setting, and GPA and sense of belonging.

#### Hypothesis 2b

Hypothesis 2b predicted that PsyCap would moderate the relationship between sense of belonging and both cognitive and affective components of psychological well-being as measured by the GHQ, SWL Scale, and PANAS. Similar to Hypothesis 2a, we expected that PsyCap would buffer the negative effects of low sense of belonging on psychological well-being.

#### Cognitive Psychological Well-Being

PsyCap and sense of belonging significantly predicted GHQ ( $\beta=.29$ ,  $p=.002$  and  $\beta=-.24$ ,  $p=.007$ , respectively; Table 5). This initial model accounted for 22% of the variance in the GHQ. The hypothesis that PsyCap would moderate the relationship

between sense of belonging and GHQ, however, was not supported as the interaction term failed to explain significant incremental variance when entered in the second step of the hierarchical regression ( $\Delta R^2=.000$ ,  $p=.971$ ).

PsyCap and sense of belonging significantly predicted SWL ( $\beta=.28$ ,  $p=.003$  and  $\beta=.25$ ,  $p=.006$ , respectively), accounting for 22% of the variance. The hypothesis that PsyCap would moderate the relationship between sense of belonging and SWL, however, was not supported as the interaction term failed to explain significant incremental variance when entered in the second step of the hierarchical regression ( $\Delta R^2=.004$ ,  $p=.39$ ; see Table 5).

#### Affective Psychological Well-Being

PsyCap significantly predicted PA, and the relationship between sense of belonging and PA was approaching significance ( $\beta=.59$ ,  $p<.001$  and  $\beta=-.14$ ,  $p=.06$ , respectively). This initial model accounted for 46% of the variance in PA. Similarly, PsyCap and sense of belonging also significantly predicted NA ( $\beta=-.31$ ,  $p=.001$  and  $\beta=-.18$ ,  $p=.05$ , respectively). This initial model accounted for 19% of the variance in NA. The hypothesis that PsyCap would moderate the relationship between sense of belonging and PA and NA was not supported as the interaction term failed to explain significant incremental variance when entered in the second step of the hierarchical regression ( $\Delta R^2=.003$ ,  $p=.313$  for PA and  $\Delta R^2=.001$ ,  $p=.731$  for NA; Table 5).

Based on the previously outlined results, Hypothesis 2b was not supported. PsyCap did not moderate the relationship between sense of belonging and measures of well-being.

### 3.3. Additional Analyses

Follow-up analyses were run to gain a more complete picture of the relationships among the variables examined in this study and to address research questions not answered by the initial hypotheses. Specifically, there were three main objectives of the analyses. First, because students are at different points in their academic careers (i.e., at different points in the pipeline), it may be important to investigate data from students at different stages in their academic process. Therefore, we broke down the sample by class

level (i.e., entry-level students [i.e., freshmen and sophomores] and advanced students [i.e., juniors and seniors]). Second, we also investigated the role of another potential moderator of the relationship between sense of belonging and important outcomes. Specifically, because the construct of engagement has a motivational/energy component, we were especially interested in the way it might change the relationship between sense of belonging and important outcomes for both advanced students and entry-level students. Finally, although we were not able to use the longitudinal data to examine the hypotheses, we were interested in examining the correlations between time one and time two. This examination provided insight into the stability of the constructs measured. Knowing how stable or malleable a construct has important implications for our ability to influence them (e.g., we may be able to develop them in individuals).

#### Additional Analyses: Hypotheses by Class Level

##### Hypothesis 1a by Class Level

As previously discussed, Hypothesis 1a predicted that PsyCap would mediate the relationship between sense of belonging and important career outcomes. Initial analyses of the entire sample found support for mediation in relation to outcomes of engagement and participants' intentions to apply to graduate programs in an area unrelated to their current major. After splitting the file into groups of entry-level students and advanced students, several patterns of relationships emerged that were not apparent in the initial analyses.

The relationship between the independent variable and the mediator was supported for all of the following variables as sense of belonging was significantly related to PsyCap ( $\beta=.64, p<.001$ ). This relationship was the same for both entry-level and advanced students. To avoid redundancy, this step will not be further discussed in the description of the results.

##### Engagement

After splitting the file into advanced students and entry-level students, the data revealed that the mediated effect was significant for advanced students, and approaching

significance for entry-level students (see Table 6). For advanced students, sense of belonging and engagement were significantly related ( $\beta=.41, p<.001$ ). The beta weight for sense of belonging was no longer significant in the presence of PsyCap at step two in the regression ( $\beta=.12, p=.31$ ), and PsyCap was significantly related to the intent when controlling for sense of belonging ( $\beta=.46, p<.001$ ). Results of the significance test suggest that there is significant mediation at the 95% confidence level (.163 to .493) for advanced students.

#### Intentions to Apply to Graduate Programs in an Area Unrelated to Their Current Major

After splitting the file into advanced and entry-level students, the mediated effect present for the whole sample remained only for advanced students in relation to intentions to apply to graduate programs in an area unrelated to the participant's current major (Table 6). For this group, sense of belonging and participant intentions to apply to graduate programs in an area unrelated to their current major were not significantly related ( $\beta=.05, p=.690$ ). The beta weight for sense of belonging was also non-significant in the presence of PsyCap at step two in the regression ( $\beta=-.19, p=.218$ ). PsyCap, on the other hand, was significantly related to the intent when controlling for sense of belonging ( $\beta=.37, p=.016$ ). Results of the significance test suggest that there is indeed significant mediation at the 95% confidence level (.099 to .864). As previously discussed, this pattern suggests a suppressed mediated effect.

#### Hypothesis 1b

Full support was found for hypothesis 1b in the initial analyses. However, splitting the file into entry-level students and advanced students revealed different patterns of relationships for each class on outcomes of cognitive well-being (as measured by GHQ and SWL), and NA.

#### General Health Questionnaire (GHQ)

While the initial analyses suggested that PsyCap mediated the relationship between sense of belonging and GHQ, after splitting the file the relationship was only significant for entry-level students. For this group, sense of belonging and GHQ were

significantly related ( $\beta=.44, p<.001$ ). The beta weight for sense of belonging was no longer significant in the presence of PsyCap at step two in the regression ( $\beta=.19, p=.140$ ), and PsyCap was significantly related to GHQ when controlling for sense of belonging ( $\beta=.44, p=.001$ ; see Table 6). Results of the significance test suggest that there is significant mediation at the 95% confidence level (.08 to .299).

#### Satisfaction with Life (SWL)

After splitting the file into advanced students and entry-level students, the data revealed that the mediated effect was being carried by entry-level students. For this group, sense of belonging and SWL were significantly related ( $\beta=.53, p<.001$ ). The beta weight for sense of belonging dropped but remained significant in the presence of PsyCap at step two in the regression ( $\beta=.25, p=.042$ ), and PsyCap was significantly related to SWL when controlling for sense of belonging ( $\beta=.43, p=.001$ ). Results of the significance test suggest that there is significant mediation at the 95% confidence level (.198 to .731; see Table 6).

#### Negative Affect (NA)

Further analyses suggest that PsyCap only mediates the relationship between sense of belonging and NA for entry-level students. Sense of belonging and NA were significantly related ( $\beta=-.44, p<.001$ ). The beta weight for sense of belonging was no longer significant in the presence of PsyCap at step two in the regression ( $\beta=-.11, p=.380$ ), and PsyCap was significantly related to NA when controlling for sense of belonging ( $\beta=-.51, p<.001$ ). Results of the significance test suggest that there is significant mediation at the 95% confidence level (-.409 to -.133; Table 6).

#### Hypothesis 2a

Hypothesis 2a predicted that PsyCap would moderate the relationship between sense of belonging and career outcomes. Initial hypotheses found support for PsyCap as a moderator of the relationships between sense of belonging and intentions to switch majors and intentions to apply to graduate programs in unrelated fields. Follow-up analyses suggest that there are different patterns of relationships for these variables

depending on class level. Specifically, these differing relationships emerged for intentions to switch majors and intentions to apply to graduate programs in an unrelated field.

#### Intentions to Switch Majors

Follow-up analyses indicate that entry-level students carried the interaction for the intentions to switch majors (see Table 7; Figure 8). PsyCap did not significantly predict participant's intentions to switch majors, but sense of belonging did significantly predict the intention ( $\beta=.18, p=.219$  and  $\beta=-.51, p=.001$ , respectively). This initial model accounted for 23% of the variance in participant intentions to switch majors. Results provide support for moderation among entry-level students as the interaction term was significant at step two of the regression ( $\Delta R^2 = .083, p=.008$ ). The interaction occurred such that among those with high belonging, there was a significant difference in intentions between those with low and high levels of PsyCap, but no significant difference in intentions from low to high PsyCap among those with a low sense of belonging ( $\beta=.54, p=.006$  and  $\beta=.13, p=.362$ , respectively). Specifically, entry-level students were least likely to switch majors with when sense of belonging was high and PsyCap was low. On the other hand, those who reported a low sense of belonging (regardless of their level of PsyCap) expressed the greatest intentions to switch majors followed by those with a high sense of belonging and high PsyCap. There was a significant change in the intentions from low belonging to high belong among those with low PsyCap, but not for those with high levels of PsyCap ( $\beta=-.63, p<.001$  and  $\beta=-.19, p=.302$ , respectively). However, intentions for all groups fell below the scale midpoint suggesting that in general, most participants did not intend to switch their majors, but some individuals were more certain than others.

#### Intentions to Apply to Graduate Programs in an Area Unrelated to Their Current Major

Further analyses suggested that advanced students carried the interaction for intentions to apply to graduate programs in an area unrelated to their current major (see Table 7; Figure 9). Similar to participant intentions to switch majors for entry-level students, PsyCap did not significantly predict participants' intentions to apply to graduate

programs in an unrelated field to their current major, but sense of belonging did significantly predict intentions for advanced students ( $\beta=.15, p=.278$  and  $\beta=-.28, p=.041$ , respectively). This initial model accounted for 7% of the variance in participant intentions to apply to graduate programs in an unrelated area. Support was found for PsyCap as a moderator of the relationship between sense of belonging and the intentions as the interaction term was significant at step two of the regression for advanced students ( $\Delta R^2 =.05, p=.029$ ). The interaction occurred such that those with the highest levels of PsyCap and the lowest sense of belonging were the most likely report intentions to apply to graduate schools in an area unrelated to their current major. These individuals were significantly more likely to report the intentions than those with low PsyCap (and a low sense of belonging;  $\beta=.33, p=.035$ ). There were no significant differences in the intentions from low to high engagement among those who also reported a high sense of belonging ( $\beta=-.11, p=.528$ ). Finally, while there were no significant changes in intentions to apply to graduate programs in an unrelated area from low to high belonging among those with low PsyCap, there was a significant difference among those with high levels of PsyCap ( $\beta=-.02, p=.992$  and  $\beta=-.43, p=.004$ , respectively).

### Hypothesis 2b

Hypothesis 2b predicted that PsyCap would moderate the relationship between sense of belonging and measures of well-being. Initial analyses did not find support for Hypothesis 2b. Similarly, follow-up analyses did not indicate any different patterns of relationships between advanced students and entry-level students.

### Additional Analyses: Sense of Belonging and Engagement

The second goal of our follow-up analyses was to investigate other potential interaction effects not investigated in the initial hypotheses, namely, the possibility of engagement as a moderator of the sense of belonging-academic and career outcome/well-being relationships. By definition, engagement consists of dedication, absorption, and vigor. Engaged STEM students are affectively connected to their studies, and are confident they can deal with the demands of their studies in STEM. Similarly, those who feel a greater sense of belonging in STEM feel that they are like others in their major who

are successful, they are confident in discussing topics related to their studies in class, and they feel connected to those around them. Thus, based on the similar mechanism that these constructs operate, it may be the case that they serve to (a) emphasize the effects of one another, or (b) serve to buffer an individual from the negative effects of having a low level of one construct but not the other. The goals of our follow-up analyses were to explore these possibilities.

Our follow-up analyses indicated that engagement and sense of belonging did in fact interact with each other on several important outcome variables. Engagement was an important factor in intentions to seek a career in research, intentions to seek a career in a clinical or applied setting, intentions to switch majors, and psychological well-being (GHQ and SWL).

#### General Health Questionnaire (GHQ)

There was an interaction between engagement and sense of belonging for both advanced students and entry-level students in terms cognitive psychological well-being (as measured by the GHQ), but the nature of the interaction was different for each group. For entry-level students, engagement did not significantly predict GHQ, but sense of belonging did ( $\beta=.13, p<.36$  and  $\beta=.39, p=.007$ , respectively). This initial model accounted for 21% of the variance in GHQ. For advanced students, on the other hand, both engagement and sense of belonging also significantly predicted GHQ ( $\beta=.24, p=.027$  and  $\beta=.25, p=.017$ , respectively). This initial model accounted for 15.1% of the variance in GHQ. For both entry-level students and advanced students, moderation was supported as the interaction term was significant at step two of the regressions ( $\Delta R^2=.057, p=.023$  and  $\Delta R^2=.115, p=.000$ , respectively).

For advanced students, engagement and sense of belonging interacted with each other such that those who reported a high sense of belonging and were also highly engaged tended to have the highest levels of well-being (see Table 8; Figure 9). There were no differences in well-being for those who were high and low on engagement when sense of belonging was low ( $\beta=-.19, p=.212$ ). There was a significant change in well-being from low engagement to high engagement among those with a high sense of

belonging ( $\beta=.55, p<.001$ ). There was also a significant effect of belonging when engagement was both high and low ( $\beta=.59, p<.001$  and  $\beta=.5, p=.001$ , respectively).

For entry-level students, instead of serving to emphasize the positive benefits of high belonging, engagement buffered the negative effects of a low sense of belonging (Figure 10). Those individuals who were less engaged and reported a lower sense of belonging experienced the lowest levels of well-being, while those who were less engaged and reported a higher sense of belonging had the highest levels of GHQ. There were no differences between individuals with high belonging on GHQ ( $\beta=-.16, p=.392$ ). These individuals perceived well-being levels that fell in the middle of the other groups. Finally, there were significant differences in GHQ from low to high belonging when engagement was low, but not when engagement was high ( $\beta=.50, p=.001$  and  $\beta=.05, p=.807$ , respectively).

#### Satisfaction with Life (SWL)

Support was found for an interaction between engagement and sense of belonging in relation to SWL for entry-level students. Both engagement and sense of belonging significantly predicted SWL ( $\beta=.34, p=.01$  and  $\beta=.31, p=.01$ , respectively). The initial model accounted for 33% of the variance in SWL for entry-level students. Furthermore, the interaction term was significant at step two of the regression ( $\Delta R^2 = .12, p=.000$ ). Those with both a low sense of belonging and low engagement reported the lowest levels of SWL. There were no differences between low and highly engaged individuals when they also had a high sense of belonging ( $\beta=-.08, p=.637$ ). These individuals reported relatively high levels of SWL across the board (see Table 8; Figure 11). Those who were highly engaged but reported a low sense of belonging, however, had higher SWL than those who were less engaged and experienced low belonging or belonging uncertainty ( $\beta=.54, p<.001$ ). Finally, while there was not a significant change in SWL from low to high belonging for those who were highly engagement, there was a significant change for those with low engagement ( $\beta=.47, p<.001$  and  $\beta=-.19, p=.287$ , respectively).

### Intentions to Apply to Graduate Programs in an Area Unrelated to Participant's Current Major

There was an interaction between engagement and sense of belonging in relation to intentions to apply to graduate school in a different field for advanced students. Engagement did not significantly predict participant's intentions to switch majors, but sense of belonging did significantly predict the intention ( $\beta=.10, p=.393$  and  $\beta=-.22, p=.05$ , respectively). This initial model accounted for 2% of the variance in participant intentions to apply to graduate programs in an area unrelated to their current major. Results provide support for moderation among advanced students as the interaction term was significant at step two of the regression ( $\Delta R^2=.107, p=.001$ ). The interaction for advanced students occurred such that those who were highly engaged but did not feel they belonged in their major were most likely to apply to graduate programs in an unrelated area to their current major; they were significantly more likely to report the intentions than those who did not feel they belong and were less engaged ( $\beta=.50, p=.002$ ). In contrast, there was no differences between individuals with low and high engagement when belonging was high ( $\beta=.10, p=-.2, p=.151$ ; see Table 8; Figure 12). Overall, individuals who perceived high belonging were least likely to report intentions to apply to graduate programs in an unrelated area. Finally, there was not a significant change in the intentions from low to high belonging for those who were less engaged, but there was a significant difference among those who were highly engaged ( $\beta=-.08, p=.564$  and  $\beta=-.55, p<.001$ , respectively).

### Intentions to Seek a Career Where Research is a Major Focus

An interaction was found between engagement and sense of belonging in relation to participant intentions to seek a career where research is a major focus for entry-level students. Neither engagement nor sense of belonging significantly predicted intentions to seek a career where research is a major focus ( $\beta=.23, p=.48$  and  $\beta=.01, p=.955$ , respectively). The initial model accounted for 13% of the variance. Moderation was supported, however, as the interaction term was significant at step two of the regression ( $\Delta R^2=.109, p=.004$ ). That is, engagement moderated the relationship between sense of belonging and intentions to seek a career where research is a major focus such that there

were no differences in the intentions from low to high engagement when belonging was low or high ( $\beta = -.08, p = .616$  and  $\beta = -.15, p = .460$ , respectively; see Table 8; Figure 13). There were also no differences on the intentions from low to high belonging when engagement was high, but there was a significant change when engagement was low ( $\beta = .3, p = .193$  and  $\beta = .37, p = .026$ , respectively).

#### Intentions to Pursue a Career in a Clinical or Applied Setting

There was an interaction between engagement and sense of belonging in relation to intentions to seek a job in a clinical or applied setting for advanced students. Neither engagement nor sense of belonging significantly predicted intentions to seek a career in a clinical or applied setting ( $\beta = .02, p = .898$  and  $\beta = .13, p = .259$ , respectively), only accounting for 5% of the variance in the intention. Moderation was supported, however, as the interaction term was significant at step two of the regression ( $\Delta R^2 = .066, p = .013$ ). The interaction occurred such that there were marginally significant differences in the intentions from low to high engagement when sense of belonging was low and high ( $\beta = .31, p = .072$  and  $\beta = -.25, p = .088$ , respectively; see Table 8; Figure 14). There was a significant change in the intentions from low to high belonging among those with low engagement, but not for those with high engagement ( $\beta = .37, p = .013$  and  $\beta = -.13, p = .404$ , respectively). Additionally, it is important to note that on average, all groups reported intentions to seek a career in research that were at least at the scale midpoint (4 on a 7-point scale), suggesting that even the least likely to pursue a career in a clinical or applied setting were only unsure of their intentions. That is, most groups reported intentions to seek such a career.

#### Additional Analyses: Longitudinal Correlations

As previously indicated, the same survey was sent out to participants at two times in the fall semester; once near the beginning of the semester and once near the end of the semester. Responses at both times were matched for 27 participants. Results of the follow-up analyses indicate that the relationships between constructs across time are fairly stable and in the expected directions (see Table 3). Measures of psychological constructs were related to other constructs more strongly than with intention measures.

Thus, the subjective constructs were more stable than were intention measures with the exception of participant intentions to switch majors and participant intentions to complete their current majors. However, the stability of the subjective constructs were, on average, moderate to strong (see Table 3). For example, sense of belonging at time one predicted engagement ( $r=.53, p=.005$ ) and PA ( $r=.71, p>.001$ ) at time two. Sense of belonging at time one predicted intentions to seek a job in a clinical/applied setting ( $r=.38, p=.05$ ) and intentions to apply to graduate programs in the same major or a related major ( $r=.46, p=.018$ ). Thus, while the constructs are generally stable, they are still malleable.

## CHAPTER 4. DISCUSSION

### General Discussion

The issue of the leaky pipeline for women in STEM fields has received great attention nationally. While the issue is well-documented, there has been little research identifying factors that contribute to the trends we see in these fields. What research has been done has either been largely qualitative in nature and/or has focused on career goal differences of men and women in these fields (e.g., Mason et al. 2009). Researchers have documented that the two groups often have different goals, but what has been missing is a more complete understanding of why career goals and intentions might be different for men and women and what role the STEM environment may play in the leaky pipeline. The current study attempts to fill these gaps in the literature by investigating the role that sense of belonging in an individual's STEM major plays in predicting important academic, professional, and personal outcomes for women. Additionally, we sought to determine the role that individual differences has in the relationships between sense of belonging and these important outcomes.

### Sense of Belonging

Overall, our results provide insight into the relationships between sense of belonging and important decisions and outcomes for women in STEM majors. As discussed previously, sense of belonging has been shown to have important implications in terms of performance for minority students in the academic environment (Walton & Cohen, 2007). Furthermore, research has found that those individuals who are primed to experience a lowered sense of belonging in computer science fields also felt discouraged from pursuing careers in computer science fields and were more likely to discourage a peer from doing so as well (Walton & Cohen, 2007). The results of the current study are consistent with the above research and support the importance of belonging in academia.

Moreover, the current research also contributes to our understanding of the construct in two ways. First, it illustrates the importance the social environment and an individual's sense of belonging for groups other than racial minority groups. That is, the results of the current study suggest that sense of belonging plays an important role in the experiences for women in male dominated fields. These results make sense as many of the negative stereotypes associated with each of these groups (i.e., racial minorities in academia and women in STEM) are targeted at their worth and skill in these domains. Because belonging has emerged as such an important variable, future research should continue to investigate the role of belonging for different groups and in additional settings (e.g., in settings/for groups where stereotypes are not targeted at skill or worth).

Finally, the results of the current study also extend previous work by establishing the role of sense of belonging in predicting factors beyond performance on a task, including well-being and academic and career outcomes. In our study, sense of belonging strongly predicted career and well-being outcomes for both advanced and entry-level students. For example, sense of belonging was related to engagement, SWL, cognitive and affective well-being, and PsyCap. Such results illustrate the importance of the social environment, including the social ties an individual has, the number and quality of female role models in the major and field overall, an individual's degree of similarity to those who are successful in their major, and an individual's overall judgment of "fit" in their major in predicting multiple outcomes for women in these disciplines. Thus, not only is it important to note that belonging strongly influences important outcomes, it is also important to note the breadth of outcomes it affects.

### Psychological Capital

PsyCap is a higher order construct consisting of hope, optimism, resilience, and self-efficacy. As discussed previously, research has demonstrated positive relationships between the higher order construct and important outcomes like well-being and performance, as well as positive relationships between each of the components and important outcomes like health (e.g., Luthans et al., 2007, Luthans et al., 2008). Because of the importance of the construct in predicting so many outcomes in the work and personal environment, the current study sought to determine the influence that PsyCap

may have in the relationship between sense of social belonging in STEM fields and important individual, academic, and career outcomes for female students.

Our results suggested that, overall, PsyCap acted as more of a mediator of the relationship between sense of belonging and outcomes as opposed to a moderator. That is, sense of belonging was positively related to PsyCap, which in turn influenced important outcomes like engagement and well-being. These results are consistent with those found in the work environment. As discussed previously, researchers found that the climate of the work environment, specifically the amount of support received in the work environment, created the conditions necessary to build PsyCap and positively influence an individual's job performance (Luthans et al., 2008). The present study demonstrated that a supportive academic environment, like a supportive work environment, was important in building the individual resources of individuals (i.e., PsyCap) which in turn predicted valued outcomes in an academic environment beyond performance and well-being. These results suggest that both social fit and individual resources like PsyCap play important role academic environments, particularly those environments like STEM where certain individuals may experience negative events.

### Additional Analyses

#### Class Level Analyses

Our initial analyses investigated possible antecedents of the leaky pipeline for a sample of female STEM undergraduates at all stages of their academic careers (i.e., the sample included students at freshmen through senior status). However, further analyses revealed that after splitting the file into advanced and entry-level students, different patterns of relationships emerged. These results are consistent with the definition of the leaky pipeline, as leaks can and do occur at every decision-making point in an individual's life. As discussed previously, the idea of a simple "pipeline" to represent the phenomena is too simplistic; there are many factors that may influence when and if leaks occur.

We found significant differences between advanced and entry-level students in sense of belonging, PsyCap, NA, participants' intentions to complete their major, and

participants' intentions to switch majors. Additionally, differences between entry-level and advanced students' intentions to seek a job in a clinical or applied setting approached significance. Specifically, advanced students had significantly higher levels of sense of belonging and PsyCap, and expressed greater intentions to complete their current majors than entry-level students. Entry-level students had significantly higher levels of NA and expressed greater intentions to switch majors than advanced students. These results make sense as entry-level students may still be entertaining different ideas for their future. In the transition from entry-level status to advanced status, experiences in both life and school may alter these career plans. Advanced students may have already made the decision to stay in STEM, at least at the undergraduate level. Additionally, it may be that advanced students in STEM majors are those individuals who were better able to cope with negative experiences, or are those individuals who had higher levels of PsyCap as entry-level students that enabled them to push through and continue on their STEM career paths. On the other hand, advanced students may also have greater "sunk costs" so to speak. That is, they may feel it is too late to change majors. Thus, they may convince themselves they belong (e.g., cognitive dissonance). Given these patterns, then, perhaps it is more appropriate for future research to discuss factors that influence academic and professional decisions for women in STEM separately at different places in the pipeline. As mentioned above, differences between entry-level and advanced students also emerged when testing our hypotheses.

When conducting our analyses using our total sample, we found an interaction between sense of belong and PsyCap in relation to participants' intentions to switch majors and intentions to apply to graduate programs in an unrelated field to their current majors. Upon splitting the file based on class, it became apparent that the relationships were being carried by one group. Interestingly, in most cases where the interaction only held for one group or another, their place in the pipeline helped to interpret the findings. For instance, for participant intentions to switch majors, the interaction was being carried by entry-level students. For participant intentions to apply to graduate programs in an unrelated field, the interaction was being carried by advanced students. These findings make sense as both items refer to participants' intentions to leave their STEM major, but clearly represent different decision-making points. The differences in the nature of the

decisions are further emphasized by the different directions of the interactions found for each group. For example, regardless of sense of belonging, Entry-level students with high levels of individual resources (PsyCap) had relatively high intention to switch their major. However, those who felt they belonged but did not have high levels of PsyCap were more likely to indicate they would not leave their STEM major (see Figures 7-8). Perhaps due to the point they are in their academic careers, those who have high levels of PsyCap may be more willing or perceive they are more able to investigate multiple career options. On the other hand, if these individuals lack individual resources like PsyCap but feel they fit where they are, they may not have the ability or desire to explore alternative career paths.

For advanced students, those with a high sense of belonging and high levels of individual resources (i.e., PsyCap: hope, optimism, resilience, self-efficacy) were least likely to intend to leave STEM. These individuals likely felt secure in their decisions regarding their STEM major and may wish to pursue advanced degrees and careers in STEM. In addition, however, advanced students with high PsyCap, but low belonging were most likely to report intentions to apply to school in an unrelated area, further highlighting how critical sense of belonging is for retaining individuals in the discipline. Those with low levels of PsyCap were less likely to express intentions to apply to graduate programs in an unrelated area, regardless of their sense of belonging. Collectively, these individuals may not be planning to attend graduate school in any field. However, for those with a high sense of belonging and low PsyCap, it may be that these individuals feel they fit well where they are and feel more secure in their current major.

In summary, it appears the same variable may act differently upon these individuals based on what stage they are at and what decisions they are making in their academic career. It may be that sense belonging becomes more refined as students go through college and bank more experiences in their major. Future research is encouraged to consider the unique decisions and experiences that students face along the pipeline. Moreover, it would be interesting to assess students longitudinally throughout their career to see how sense of belonging changes across time.

### Engagement

Additional analyses exploring the role of engagement uncovered some interesting relationships and patterns, and highlighted the importance of the construct for predicting outcomes for both advanced and entry-level students. For example, the nature of the interactions between sense of belonging and engagement and between sense of belonging and PsyCap in relation to participants' intentions to apply to graduate programs in an area unrelated to their current majors was very similar. This may be due to the idea that engaged individuals may create their own personal and professional resources like social support networks (Xanthopoulou, et al., 2009). Although different definitions of engagement exist, most definitions emphasize the active, motivational, and connection aspects of the construct (Schauefeli et al., 2001). In both interactions it appears that it is those who are either highly engaged in school or who have high levels of resource variables like PsyCap that are expressing the greatest intentions to apply to programs outside of STEM fields (See Figures 8 and 10).

For entry-level students, engagement appears to be especially important. For these individuals, high levels of engagement had a strong influence in producing more favorable outcomes when sense of belonging was low. That is, in several circumstances for entry-level students, the effects of a low sense of belonging were buffered by high levels of engagement. For example, if an individual did not feel they fit well within their current major, it did not matter as much if their engagement was high. This makes sense considering the motivational and commitment components of the construct. However, students who reported low belonging and low engagement also reported the lowest levels of psychological well-being, and were less likely to indicate intentions to seek a career where research was a major focus.

### Longitudinal Analyses

While there were only 27 people who completed the survey at both time periods, correlations between the focal variables at time one and time two were fairly strong. The idea that variables could predict other variables almost two months later is meaningful. For example, sense of belonging scores at time one and time two were strongly correlated ( $r=.87, p>.001$ ) and PsyCap scores at time one and time two were strongly correlated

( $r=.67, p>.001$ ). Additionally, sense of belonging at time one was also strongly correlated with PsyCap at time two ( $r=.70, p>.001$ ). Considering the strengths of the relationships found in the current study as well as the impact that the investigated variables could have in the leaky pipeline, it is encouraging to know that efforts to foster these important constructs in individuals may produce meaningful results in keeping women in STEM fields. The idea that we could influence factors that predict academic, career, and personal outcomes for women is especially important in relation to PsyCap and sense of belonging.

In sum, the results of our analyses provide valuable insight into processes that may lead to leaks in the pipeline of STEM fields. The messages we send to women in STEM and their social experiences within their major can affect the choices they make in the future. These results advance our understanding of the leaky pipeline phenomena of women in STEM by identifying possible reasons for leaks for its occurrence.

#### 4.1. Contributions

##### Theoretical Contributions

There were two goals of the present study. The first and primary goal was to identify antecedents of the leaky pipeline in STEM field. Specifically, we were interested in how perceptions of social belonging in STEM majors predict the decisions that women in these domains make, and how perceptions of one's social belonging in this environment interact with individual differences to affect important psychological and career outcomes. Second, we sought to empirically test a portion of the Ashburn-Nardo and Williams (2009) model of belonging uncertainty in an academic context. While this model is based on literature in the area, as previously discussed, it has not been tested itself. These goals and the results of this study offer several unique theoretical contributions to several domains of literature including belonging, PsyCap, and engagement.

With regard to the first goal of the present study, our results provided support for the idea that social experiences in the academic STEM environment play an important role in influencing important outcomes for women in STEM fields. In the current study,

PsyCap played more of a mediating role in the relationship between sense of belonging and important academic and career outcomes. That is, in general, sense of belonging affected many of the academic and professional outcomes and decisions for women in STEM through the individual resources for these individuals (i.e., PsyCap). This pattern of relationship is particularly true for well-being measures and replicates those found in previous studies using a working population (e.g., Avey et al., 2010, Luthans et al., 2007).

Finally, this research provided an initial empirical testing a portion of the Ashburn-Nardo and Williams (2009) model. As mentioned, the model was constructed based on industrial and organizational psychology and social psychology literature. However, testing the components together was an important step to validating the model and describing the process of belonging uncertainty in an academic setting. The empirical support provided for both the model, the influence of belonging on important outcomes, and the role of PsyCap in academic domains will serve as an important starting point for future research questions and the development of targeted interventions for keeping women in STEM.

#### Applied Contributions

While the goals and results of the current study provided valuable theoretical contributions to the literature, they also provide us with several significant practical contributions in terms of what universities and academic departments can do to encourage and support the continuation of women in these disciplines at different stages of the pipeline. In fact, the results of the present study and those of the studies discussed previously suggest that universities may not be doing their part in preventing these trends. As noted above, simple encouragement has not been an effective means to increasing the proportion of women in STEM fields at higher levels of the pipeline (Moyer et al., 1999). The numbers of women in these fields suggest that while encouragement may be an effective means of getting women “in the door” so to speak, it is not effective at keeping them there.

The results of our study suggest that the environment of STEM may both directly and indirectly play a role in women’s academic and career decisions, echoing the message provided by Cheryan and colleagues which propose that interest in fields can be

changed simply by manipulating the objects in the environment (Cheryan, Davies, Plaut, & Steele, 2009). In their study, simply switching out a Star Trek poster for a nature poster on the wall was sufficient to increase women's interest in computer science. Thus, working to change not only the types of experiences women have in their STEM majors but also the image of STEM, even at most micro levels, may be an important initial step in maintaining diversity at all levels of the pipeline. For example, simple changes in the way opportunities are delegated, the way majors are advertised, or even the interactions between advisors and students in these fields should be considered more closely.

Universities could also consider creating and targeting interventions more directly at each stage of the pipeline. For example, since engagement emerged as an important variable, identifying ways to foster high levels of engagement in academics for students from the beginning of their academic careers may be especially important. Additionally, identifying more individually-targeted holistic-level interventions (as opposed to interventions targeted at specific groups in the pipeline) aimed at increasing these individual's sense of belonging may also have a positive impact, as demonstrated for minority students in Walton and Cohen's research (2007). In their study, sense of belonging was tied to the degree of negative events experienced on a daily basis for minority students, but was independent of negative events experienced for non-minority students. However, the researchers found that by communicating that most people worry about belonging on campus initially, it reduced the degree to which minority students' sense of belonging was directly tied to experienced negative events. In fact, minority students in the experimental condition (those who experienced an intervention that addressed social belonging vs. those in a control condition who experienced an intervention that addressed social-political views) spent, on average, 1 hour and 22 minutes longer studying each day and sent three times more emails than minorities in the control condition (Walton & Cohen, 2007). These results provide hope that similar interventions could be successful for women in STEM.

Finally, the role of PsyCap as a mediating variable suggests that universities seeking to increase their representation of women in STEM fields should not only work to change the image of their programs and the experiences individuals have, but to foster the psychological resources of women who are present. Our research suggests that

individual resources variables are powerful in that they have a direct relationship with many important outcomes for women in STEM. Therefore, the ability to develop the individual resources of women in STEM through this variable is encouraging as it could serve as a means generate more favorable outcomes for women in STEM. Attempts to develop students' PsyCap may even overlap with attempts to create a sense of belonging for women. For example, similar to those discussed above, efforts to develop the individual resources of women in STEM could include providing opportunities for women in STEM to connect, developing mentoring networks for female students or even by simply providing a supportive environment through which women can work to develop their psychological resources (e.g., Mendoza-Denton et al., 2006; Luthans et al., 2008).

#### 4.2. Limitations and Future Research

This study is not without limitations. First, our sample was relatively heterogeneous in terms of the gender saturation of STEM majors recruited. For example, we considered psychology majors, a major that tends to have greater numbers of women in it than other STEM majors, in our analyses. The major concern with this is that majors that are more saturated with male or female students could produce differences in scores on measures, particularly measures of belonging. Although our analyses provided evidence that there were no differences between psychology majors (e.g., a discipline that tends to have more women in it than other STEM majors) and other STEM majors, this may not be the case in every population. For example, in the sample for the present study, psychology is housed with the School of Science. Future studies would benefit by testing these relationships in additional populations and with different points of comparison (e.g., populations where psychology is not housed in the school of science, at institutions with varying degrees of research emphasis, by directly comparing the patterns of relationships among the investigated variables for men and women).

Second, the results of our follow-up analysis clearly indicate that there are differences in the pattern of relationships between the investigated variables at each decision-making point. While our study investigated antecedents of leaks at two points in the leaky pipeline, future research would benefit by investigating additional

relationships at additional decision making points (e.g., graduate students, post-graduate students). Furthermore, a longitudinal study that investigates the patterns of relationships between the variables investigated in the present for the same individual over time would provide valuable insight into the stability of the constructs and the degree of influence they exert at each stage of an individual's life.

Lastly, sample size posed a problem in the current study. For example, there were only 27 participant matches for time one and time two data. Furthermore, while we did obtain a sample of 182 at time one, this was not a large enough sample to investigate the proposed relationships using Structural Equation Modeling (SEM). This puts our study at risk for both type one errors in that we had to run separate regressions for each of the investigated outcomes, and type two errors in that spitting the file into entry-level and advanced students significantly reduced our sample size, and thus our power to detect effects. Future research should seek to replicate our results with a larger sample size and testing the Ashburn-Nardo and Williams (2009) model using SEM.

#### 4.3. Conclusion

While the leaky pipeline is a widely known phenomenon with much literature establishing its presence, little is known regarding its causes. The present study provides valuable insight into the factors that affect leaks in the pipeline of STEM fields for women. Because present knowledge of the factors that contribute to the leaks are limited, this valuable insight will aid in developing research questions. As previously noted, simple encouragement of women into STEM fields has not been effective. If we can increase our understanding of the leaky pipeline, it can help us to develop interventions and maintain greater numbers of women at each level of the pipeline.

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\*Asterisks denote references cited only in Appendix A: Proposal Introduction.

## TABLES

Table 1 Correlations between Variables at Time One

Variable T1	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. PsyCap	4.55	.63	<b>(.92)</b>	.												
2. Belonging	5.25	.88	.65**	<b>(.91)</b>												
3. GHQ	2.75	.52	.45**	.43**	<b>(.84)</b>											
4. Engagement	4.66	.89	.54**	.53**	.37**	<b>(.91)</b>										
5. PA	2.03	.73	.68**	.52**	.51**	.64*	<b>(.89)</b>									
6. NA	3.58	.73	-.43**	-.38**	-.52**	-.12	-.25**	<b>(.87)</b>								
7. SWL	5.03	1.44	.44**	.44**	.44**	.36*	.47**	-.26**	<b>(.92)</b>							
8. Clinical	5.11	1.94	.13 <sup>+</sup>	.16*	.11	.06	.21**	.01	.2*	<b>N/A</b>						
9. Research	3.68	1.90	.14 <sup>+</sup>	.15 <sup>+</sup>	.14 <sup>+</sup>	.32*	.20**	0	.07	-.06	<b>N/A</b>					
10. GP- Related	2.88	1.94	.18*	.19*	.11	.29*	.21**	-.03	.06	.25*	.24*	<b>N/A</b>				
11. GP-Unrelated	5.20	1.95	.09	-.08	-.11	.06	.05	.07	-.05	-.05	.02	-.21**	<b>N/A</b>			
12. Switch Major	2.05	1.62	-.21**	-.37**	-.24**	-.11	-.13 <sup>+</sup>	.37**	-.14 <sup>+</sup>	-.03	-.06	-.17*	.36**	<b>N/A</b>		
13. Complete	6.37	1.23	.22**	.32**	.03	.15 <sup>+</sup>	.06	-.15 <sup>+</sup>	.15*	.01	.14 <sup>+</sup>	.22**	-.19*	-.62**	<b>N/A</b>	
14. GPA	3.37	.43	.12	.08	-.04	.02	.03	.04	.03	-.09	.05	.11	-.17*	-.03	.08	<b>N/A</b>

\*Correlation is significant at  $p < .05$  (2-tailed); \*\*Correlation is significant at  $p < .01$  (2-tailed); <sup>+</sup>Correlation is significant at  $p < .10$  (2-tailed)

Key: PsyCap=Psychological capital; Belonging=Sense of belonging; GHQ=General health questionnaire; PA=Positive Affect; NA=Negative affect; SWL=Satisfaction with life; Clinical=Participant intentions to seek a job in a clinical/applied setting; Research=Participant intentions to seek a job where research is a major focus; GP-Related=Participant intentions to apply to graduate programs in the same or a related major; GP-Unrelated=Participant intentions to apply to graduate programs in an area unrelated to their current major; Switch=Participant intentions to switch majors; Complete=Participant intentions to complete their major; GPA=Grade point average

Table 2 Correlations between Variables at Time Two

Variable T2	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. PsyCap	4.53	.83	<b>(.95)</b>													
2. Belonging	5.17	.96	.65**	<b>(.94)</b>												
3. GHQ	4.18	.44	.53**	.46**	<b>(.77)</b>											
4. Engagement	4.47	.99	.46**	.51**	.28*	<b>(.93)</b>										
5. PA	3.54	.81	.69**	.57**	.58**	.59**	<b>(.92)</b>									
6. NA	2.09	.78	-.54**	-.47**	-.35**	-.20 <sup>+</sup>	-.41**	<b>(.89)</b>								
7. SWL	4.82	1.41	.19 <sup>+</sup>	.3**	.38**	.26*	.29*	-.08	<b>(.91)</b>							
8. Clinical	4.79	2.02	.11	.27*	-.08	.22	.09	.07	.15	<b>N/A</b>						
9. Research	3.74	1.97	.10	.10	-.12	.47**	.22*	-.14	-.02	.24*	<b>N/A</b>					
10. GP- Related	4.89	2.00	.31**	.37**	.10	.52**	.41**	-.12	-.09	.35**	.31**	<b>N/A</b>				
11. GP-Unrelated	3.00	2.03	-.19 <sup>+</sup>	-.24*	.07	.08	.04	.24*	.15	-.32**	-.14	-.32**	<b>N/A</b>			
12. Switch Major	2.14	1.67	-.46**	-.50**	-.36**	-.29**	-.49**	.4**	-.10	-.03	.04	-.27*	.28*	<b>N/A</b>		
13. Complete Major	6.18	1.38	.40**	.40**	.21 <sup>+</sup>	.47**	.39**	-.26*	.19 <sup>+</sup>	.14	.12	.38**	-.13	-.71**	<b>N/A</b>	
14. GPA	3.27	.53	.32**	.27*	.11	.28*	.26*	-.22	-.05	.10	.36**	.30*	.01	-.29*	.39**	<b>N/A</b>

\*Correlation is significant at  $p < .05$  (2-tailed); \*\*Correlation is significant at  $p < .01$  (2-tailed); <sup>+</sup>Correlation is significant at  $p < .10$  (2-tailed)

Key: PsyCap=Psychological capital; Belonging=Sense of belonging; GHQ=General health questionnaire; PA=Positive Affect; NA=Negative affect; SWL=Satisfaction with life; Clinical=Participant intentions to seek a job in a clinical/applied setting; Research=Participant intentions to seek a job where research is a major focus; GP-Related=Participant intentions to apply to graduate programs in the same or a related major; GP-Unrelated=Participant intentions to apply to graduate programs in an area unrelated to their current major; Switch=Participant intentions to switch majors; Complete=Participant intentions to complete their major; GPA=Grade point average

Table 3 Correlations between Variables at Time One and Time Two

Variable	1 <sup>b</sup>	2 <sup>b</sup>	3 <sup>b</sup>	4 <sup>b</sup>	5 <sup>b</sup>	6 <sup>b</sup>	7 <sup>b</sup>	8 <sup>b</sup>	9 <sup>b</sup>	10 <sup>b</sup>	11 <sup>b</sup>	12 <sup>b</sup>	13 <sup>b</sup>	14 <sup>b</sup>
1. PsyCap <sup>a</sup>	<b>.67**</b>	.7 <sup>*</sup>	.55 <sup>**</sup>	.59 <sup>**</sup>	.76 <sup>**</sup>	-.28	.32	.31	.15	.49 <sup>*</sup>	-.07	-.45 <sup>*</sup>	.62 <sup>**</sup>	.11
2. Belonging <sup>a</sup>	.7 <sup>**</sup>	<b>.87**</b>	.44 <sup>*</sup>	.53 <sup>**</sup>	.71 <sup>**</sup>	-.41 <sup>*</sup>	.09	.38 <sup>*</sup>	.21	.46 <sup>*</sup>	-.21	-.37 <sup>+</sup>	.44 <sup>*</sup>	-.1
3. GHQ <sup>a</sup>	.48 <sup>*</sup>	.41 <sup>*</sup>	<b>.61**</b>	.32 <sup>+</sup>	.58 <sup>**</sup>	-.35 <sup>+</sup>	.15	.23	.1	.25	-.08	-.49 <sup>**</sup>	.48 <sup>*</sup>	-.07
4. Engagement <sup>a</sup>	.31	.44 <sup>*</sup>	.21	<b>.67**</b>	.46 <sup>*</sup>	-.29	-.02	.16	.47 <sup>*</sup>	.4 <sup>*</sup>	-.33 <sup>+</sup>	-.32	.37 <sup>+</sup>	.01
5. PA <sup>a</sup>	.62 <sup>**</sup>	.62 <sup>**</sup>	.5 <sup>**</sup>	.58 <sup>**</sup>	<b>.87**</b>	-.23	.2	.31	.14	.51 <sup>**</sup>	-.04	-.47 <sup>*</sup>	.61 <sup>**</sup>	.01
6. NA <sup>a</sup>	-.5 <sup>**</sup>	-.36 <sup>+</sup>	-.55 <sup>**</sup>	-.34 <sup>+</sup>	-.51 <sup>**</sup>	<b>.29</b>	-.1	.13	-.07	-.09	-.33 <sup>+</sup>	.4 <sup>*</sup>	-.53 <sup>**</sup>	.08
7. SWL <sup>a</sup>	.36 <sup>+</sup>	.24	.62 <sup>**</sup>	.28	.38 <sup>*</sup>	-.09	<b>.52**</b>	.28	-.06	.13	.1	-.18	.44 <sup>*</sup>	-.11
8. Clinical <sup>a</sup>	.21	.39 <sup>*</sup>	.28	.13	.22	.22	.24	<b>.81**</b>	-.05	.46 <sup>*</sup>	-.13	.08	.08	-.12
9. Research <sup>a</sup>	-.08	.21	-.08	.22	-.06	-.39 <sup>+</sup>	0	-.03	<b>.46*</b>	.04	-.23	-.06	-.22	.05
10 GP-Related <sup>a</sup>	.16	.34	-.03	.09	.21	-.12	-.19	.42 <sup>*</sup>	.33 <sup>+</sup>	<b>.57**</b>	-.41 <sup>*</sup>	-.13	-.08	.1
11 GP-Unrelated <sup>a</sup>	.2	.07	.19	-.24	.03	-.28	.17	-.22	-.22	-.43 <sup>*</sup>	<b>.02</b>	.01	.01	-.38 <sup>+</sup>
12 Switch <sup>a</sup>	-.36 <sup>+</sup>	-.35 <sup>+</sup>	-.44 <sup>*</sup>	-.28	-.52 <sup>**</sup>	.22	-.19	.08	-.01	-.07	-.15	<b>.51**</b>	-.33 <sup>+</sup>	.01
13 Complete <sup>a</sup>	.57 <sup>**</sup>	.44 <sup>*</sup>	.62 <sup>**</sup>	.29	.62 <sup>**</sup>	-.37 <sup>+</sup>	.49 <sup>**</sup>	.11	-.08	.25	-.04	-.39 <sup>*</sup>	<b>.51**</b>	-.02
14 GPA <sup>a</sup>	-.06	0	0	.3	.21	.1	-.05	.16	.52 <sup>**</sup>	.31	.05	.09	.03	<b>.99**</b>

\*Correlation is significant at  $p < .05$  (2-tailed); \*\*Correlation is significant at  $p < .01$  (2-tailed); <sup>+</sup>Correlation is significant at  $p < .10$  (2-tailed); <sup>a</sup>Time one variable; <sup>b</sup>Time two variable

Key: PsyCap=Psychological capital; Belonging=Sense of belonging; GHQ=General health questionnaire; PA=Positive Affect; NA=Negative affect; SWL=Satisfaction with life; Clinical=Participant intentions to seek a job in a clinical/applied setting; Research=Participant intentions to seek a job where research is a major focus; GP-Related=Participant intentions to apply to graduate programs in the same or a related major; GP-Unrelated=Participant intentions to apply to graduate programs in an area unrelated to their current major; Switch=Participant intentions to switch majors; Complete=Participant intentions to complete their major; GPA=Grade point average

Table 4 Mediation Analyses

	Career Outcomes						Psychological Well-Being					
	Engagement	Complete	Switch	GP-Related	GP-Unrelated	Research	Clinical	GPA	GHQ	SWL	PA	NA
X → Y	<i>r</i> =.53**	<i>r</i> =.32**	<i>r</i> =-.37**	<i>r</i> =.19*	<i>r</i> = -.08	<i>r</i> =.15	<i>r</i> =.16*	<i>r</i> =.08	<i>r</i> =.43**	<i>r</i> =.44**	<i>r</i> =.52**	<i>r</i> =-.38**
X → M	<i>r</i> =.65**	<i>r</i> =.65**	<i>r</i> =.65**	<i>r</i> =.65**	<i>r</i> = .65**	<i>r</i> =.65**	<i>r</i> =.65**	<i>r</i> =.65**	<i>r</i> =.65**	<i>r</i> =.65**	<i>r</i> =.65**	<i>r</i> =.65**
M → Y	$\beta$ =.34**	$\beta$ =.03	$\beta$ =.06	$\beta$ =.09	$\beta$ =.25**	$\beta$ =.08	$\beta$ =.05	$\beta$ =.11	$\beta$ =.29**	$\beta$ =.28**	$\beta$ =.59**	$\beta$ =-.31**
Controlling for X												
X → Y	$\beta$ =.31**	$\beta$ =.30	$\beta$ =.41**	$\beta$ =.12	$\beta$ =-.25**	$\beta$ =.10	$\beta$ =.13	$\beta$ =.01	$\beta$ =.24**	$\beta$ =.25**	$\beta$ =.14*	$\beta$ =-.18*
Controlling for M												
Significance (95% Confidence)	.114 to .343	-.148 to .202	-.155 to .297	-.148 to .425	.099 to .864	-.17 to .39	-.214 to .358	-.032 to .101	.043 to .185	.103 to .493	.227 to .418	-.271 to -.069

\*Statistic is significant at  $p < .05$  (2-tailed); \*\*Statistic is significant at  $p < .01$  (2-tailed)

Key: X=Independent variable (Sense of belonging); M=Mediator (Psychological capital); Y=Outcome; PsyCap=Psychological capital; Belonging=Sense of belonging; GHQ=General health questionnaire; PA=Positive Affect; NA=Negative affect; SWL=Satisfaction with life; Clinical=Participant intentions to seek a job in a clinical/applied setting; Research=Participant intentions to seek a job where research is a major focus; GP-Related=Participant intentions to apply to graduate programs in the same or a related major; GP-Unrelated=Participant intentions to apply to graduate programs in an area unrelated to their current major; Switch=Participant intentions to switch majors; Complete=Participant intentions to complete their major; GPA=Grade point average

Table 5 Hierarchical Regression Analyses of Belonging-PsyCap Interaction

Model/ Predictor	Engagement			Complete			Switch			GP-Related			GP-Unrelated			Research		
	$\beta$	$R^2$	$\Delta R^2$	$\beta$	$R^2$	$\Delta R^2$	$B$	$R^2$	$\Delta R^2$	$\beta$	$R^2$	$\Delta R^2$	$\beta$	$R^2$	$\Delta R^2$	$\beta$	$R^2$	$\Delta R^2$
<i>Step 1</i>		.35**			.1**			.14**			.04*			.04*			.03	
Belonging <sup>a</sup>	.31**			.3**			-.41**			.12			-.24*			.1		
PsyCap <sup>a</sup>	.34**			.03			.06			.09			.25*			.08		
<i>Step 2</i>		.35	.003		.1	.003		.17*	.03*		.04	.001		.07*	.032*		.03	.002
Belonging <sup>a</sup>	.3**			.29**			-.38**			.12			-.26**			.09		
PsyCap <sup>a</sup>	.32**			.01			.11			.09			.2			.07		
PsyCapX	-.06			-.06			.2*			-.03			-.19*			-.05		
Belonging <sup>b</sup>																		

\*Statistic is significant at  $p < .05$  (2-tailed); \*\*Statistic is significant at  $p < .01$  (2-tailed); <sup>a</sup>Centered variable; <sup>b</sup>Interaction term of centered variables

Key:  $\beta$ =standardized regression coefficient;  $R^2$ =variance explained;  $\Delta R^2$ =change in variance explained; SWL=Satisfaction with life; Complete= Participant intentions to complete their major; Switch= Participant intentions to switch majors; GP-Related= Participant intentions to apply to graduate programs in the same or a related major; GP-Unrelated= Participant intentions to apply to graduate programs in an area unrelated to their current major

Table 5 Continued

Model/Predictor	Clinical			GPA			GHQ			SWL			PA			NA		
	$\beta$	$R^2$	$\Delta R^2$	$\beta$	$R^2$	$\Delta R^2$	$\beta$	$R^2$	$\Delta R^2$	$\beta$	$R^2$	$\Delta R^2$	$\beta$	$R^2$	$\Delta R^2$	$\beta$	$R^2$	$\Delta R^2$
<i>Step 1</i>		.03		.01			.23**			.23			.47**			.2**		
Belonging <sup>a</sup>	.13			.01			.24**			.25**			.14			-.18*		
PsyCap <sup>a</sup>	.05			.11			.29**			.28**			.59**			-.31**		
<i>Step 2</i>		.05	.018	.02	.003		.23	.0		.24	.004		.47	.003		.2	.001	
Belonging <sup>a</sup>	.11			.02			.24**			.25**			.15*			-.18		
PsyCap <sup>a</sup>	.01			.12			.29**			.26**			.6**			-.3**		
PsyCapXBelonging <sup>b</sup>	-.15			.06			.0			-.06			.06			.03		

\*Statistic is significant at  $p < .05$  (2-tailed); \*\*Statistic is significant at  $p < .01$  (2-tailed); <sup>a</sup>Centered variable; <sup>b</sup>Interaction term of centered variables

Key:  $\beta$ =standardized regression coefficient;  $R^2$ =variance explained;  $\Delta R^2$ =change in variance explained; Research=Participant intentions to seek a job where research is a major focus; Clinical= Participant intentions to seek a job in a clinical/applied setting; GPA=Grade point average; GHQ=General Health Questionnaire; PA=Positive affect; NA=Negative affect

Table 6 Significant Mediated Effects by Group

	Entry-Level Students				Advanced Students	
	Engagement <sup>a</sup>	SWL	GHQ	NA	Engagement	GP- Unrelated
X → Y	$r=.65^{**}$	$r=.53^{**}$	$r=.44^{**}$	$r=-.44^{**}$	$r=.41^{**}$	$r=.05$
X → M	$r=.64^{**}$	$r=.64^{**}$	$r=.64^{**}$	$r=.64^{**}$	$r=.64^{**}$	$r=.64^{**}$
M → Y Controlling for X	$\beta=.22$	$\beta=.43^{**}$	$\beta=.44^{**}$	$\beta=-.51^{**}$	$\beta=.46^{**}$	$\beta=.37^*$
X → Y Controlling for M	$\beta=.51^{**}$	$\beta=.25^*$	$\beta=.19$	$\beta=-.112$	$\beta=.12$	$\beta=-.19$
Significance (95% Confidence)		.198 to .731	.08 to .299	-.409 to - .133	.163 to .493	.099 to .864

\*Statistic is significant at  $p < .05$  (2-tailed); \*\*Statistic is significant at  $p < .01$  (2-tailed)

Key: X=Independent variable (Sense of belonging); M=Mediator (Psychological capital); Y=Outcome; SWL=Satisfaction with life; GHQ=General health questionnaire; NA=Negative affect; GP-Unrelated=Participant intentions to apply to graduate programs in an area unrelated to their current major

Table 7 Significant Hierarchical Regression Analyses of Belonging-PsyCap Interaction by Group

Model/Predictor	Entry-Level Students			Advanced Students		
	<i>B</i>	<i>R</i> <sup>2</sup>	$\Delta R^2$	$\beta$	<i>R</i> <sup>2</sup>	$\Delta R^2$
<i>Step 1</i>		.18**			.05	
Belonging <sup>a</sup>	-.51**			-.28*		
PsyCap <sup>a</sup>	.18			.15		
<i>Step 2</i>		.26**	.083*		.10*	.05*
Belonging <sup>a</sup>	-.41**			-.23		
PsyCap <sup>a</sup>	.33*			.11		
PsyCapXBelonging <sup>b</sup>	.37**			-.23*		

\*Statistic is significant at  $p < .05$  (2-tailed); \*\*Statistic is significant at  $p < .01$  (2-tailed); <sup>a</sup>Centered variable; <sup>b</sup>Interaction term of centered variables

Key:  $\beta$ =standardized regression coefficient;  $R^2$ =variance explained;  $\Delta R^2$ =change in variance explained; Switch=Participant intentions to switch majors; GP-Unrelated=Participant intentions to apply to graduate programs in an area unrelated to their current major

Table 8 Significant Hierarchical Regression Analyses of Belonging-Engagement Interaction for Entry-Level Students

Model/Predictor	Entry-Level Students								
	SWL			Research			GHQ		
	$\beta$	$R^2$	$\Delta R^2$	$\beta$	$R^2$	$\Delta R^2$	$\beta$	$R^2$	$\Delta R^2$
<i>Step 1</i>		.35**			.05			.23**	
Belonging <sup>a</sup>	.31*			.01			.39**		
Engagement <sup>a</sup>	.34**			.23			.13		
<i>Step 2</i>		.47**	.12**		.16**	.109**		.29*	.057*
Belonging <sup>a</sup>	.15			-.15			.28		
Engagement <sup>a</sup>	.23			.12			.05		
BelongingXEngagement <sup>b</sup>	-.43**			-.41**			-.29*		

\*Statistic is significant at  $p < .05$  (2-tailed); \*\*Statistic is significant at  $p < .01$  (2-tailed); <sup>a</sup>Centered variable; <sup>b</sup>Interaction term of centered variables

Key:  $\beta$ =standardized regression coefficient;  $R^2$ =variance explained;  $\Delta R^2$ =change in variance explained; SWL=Satisfaction with life; Research=Participant intentions to seek a job where research is a major focus; GHQ=General Health Questionnaire; GP-Unrelated=Participant intentions to apply to graduate programs in an area unrelated to their current major; Clinical=Participant intentions to seek a job in a clinical/applied setting

Table 9 Significant Hierarchical Regression Analyses of Belonging-Engagement Interaction for Advanced Students

Model/Predictor	Advanced Students								
	GP-Unrelated			Clinical			GHQ		
	$\beta$	$R^2$	$\Delta R^2$	$\beta$	$R^2$	$\Delta R^2$	$\beta$	$R^2$	$\Delta R^2$
<i>Step 1</i>		.04			.02			.17**	
Belonging <sup>a</sup>	-.22*			.13			.25*		
Engagement <sup>a</sup>	.1			-.02			.24*		
<i>Step 2</i>		.15**	.107**		.08*	.066*		.28**	.115**
Belonging <sup>a</sup>	-.23*			.12			.26**		
Engagement <sup>a</sup>	.15			.03			.18		
BelongingXEngagement <sup>b</sup>	-.33**			-.29*			.34**		

\*Statistic is significant at  $p < .05$  (2-tailed); \*\*Statistic is significant at  $p < .01$  (2-tailed); <sup>a</sup>Centered variable; <sup>b</sup>Interaction term of centered variables

Key:  $\beta$ =standardized regression coefficient;  $R^2$ =variance explained;  $\Delta R^2$ =change in variance explained; SWL=Satisfaction with life; Research=Participant intentions to seek a job where research is a major focus; GHQ=General Health Questionnaire; GP-Unrelated=Participant intentions to apply to graduate programs in an area unrelated to their current major; Clinical=Participant intentions to seek a job in a clinical/applied setting

Table 10 Summary of Supported Hypotheses

	Whole Sample	Advanced Students	Entry-Level Students
Mediation	<ul style="list-style-type: none"> <li>• <i>Career Outcomes</i> <ul style="list-style-type: none"> <li>○ Engagement</li> <li>○ Intentions to Apply to Graduate Programs in an Area Unrelated Field</li> </ul> </li> <li>• <i>Psychological Well-Being</i> <ul style="list-style-type: none"> <li>○ GHQ</li> <li>○ SWL</li> <li>○ Positive Affect</li> <li>○ Negative Affect</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <i>Career Outcomes</i> <ul style="list-style-type: none"> <li>○ Engagement</li> <li>○ Intentions to Apply to Graduate Programs in an Area Unrelated Field</li> </ul> </li> <li>• <i>Psychological Well-Being</i> <ul style="list-style-type: none"> <li>○ N/A</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <i>Career Outcomes</i> <ul style="list-style-type: none"> <li>○ Engagement*</li> </ul> </li> <li>• <i>Psychological Well-Being</i> <ul style="list-style-type: none"> <li>○ GHQ</li> <li>○ SWL</li> <li>○ Negative Affect</li> </ul> </li> </ul>
Moderation	<ul style="list-style-type: none"> <li>• <i>Career Outcomes</i> <ul style="list-style-type: none"> <li>○ Intentions to Switch Majors</li> <li>○ Intentions to Apply to Graduate Programs in an Unrelated Field</li> <li>○ Intentions to Pursue a Career in a Clinical or Applied Setting*</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <i>Career Outcomes</i> <ul style="list-style-type: none"> <li>○ Intentions to Apply to Graduate Programs in an Unrelated Field</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <i>Career Outcomes</i> <ul style="list-style-type: none"> <li>○ Intentions to Switch Majors</li> </ul> </li> </ul>

\*Regression coefficient is marginally significant at  $p \leq .10$  (2-tailed)

Table 11 Mean Differences between Entry-Level Students and Advanced Students on All Investigated Variables

	t	df	Mean Difference	Levene's Test (F)
Belonging	-2.62**	163	-.36	1.66
Psycap	-2.81**	163	-.27	.388
Engagement	-1.44	163	-.20	.038
GHQ	-.82	163	-.07	2.35
SWL	.18	162	.04	.105
PA	-1.57	163	-.18	.10
NA	3.30**	163	.37	1.03
Complete	-3.58**	163	-.67	1.36
Switch	4.73**	163	1.14	18.67**
Gp-Related	.81	163	.25	31.26**
Gp-Unrelated	.31	163	.09	2.68
Research	.65	164	.19	4.64*
Clinical	1.84 <sup>a</sup>	163	.56	5.08*
GPA	.54	145	.04	4.10*

\*Statistic is significant at  $p < .05$  (2-tailed); \*\*Statistic is significant at  $p < .01$  (2-tailed); <sup>a</sup>Marginally significant; Entry-level students=0, Advanced students=1

Key:PsyCap=Psychological capital; Belonging=Sense of belonging; GHQ=General health questionnaire; PA=Positive Affect; NA=Negative affect; SWL=Satisfaction with life; Clinical=Participant intentions to seek a job in a clinical/applied setting; Research=Participant intentions to seek a job where research is a major focus; GP-Related=Participant intentions to apply to graduate programs in the same or a related major; GP-Unrelated=Participant intentions to apply to graduate programs in an area unrelated to their current major; Switch=Participant intentions to switch majors; Complete=Participant intentions to complete their major; GPA=Grade point average

## FIGURES

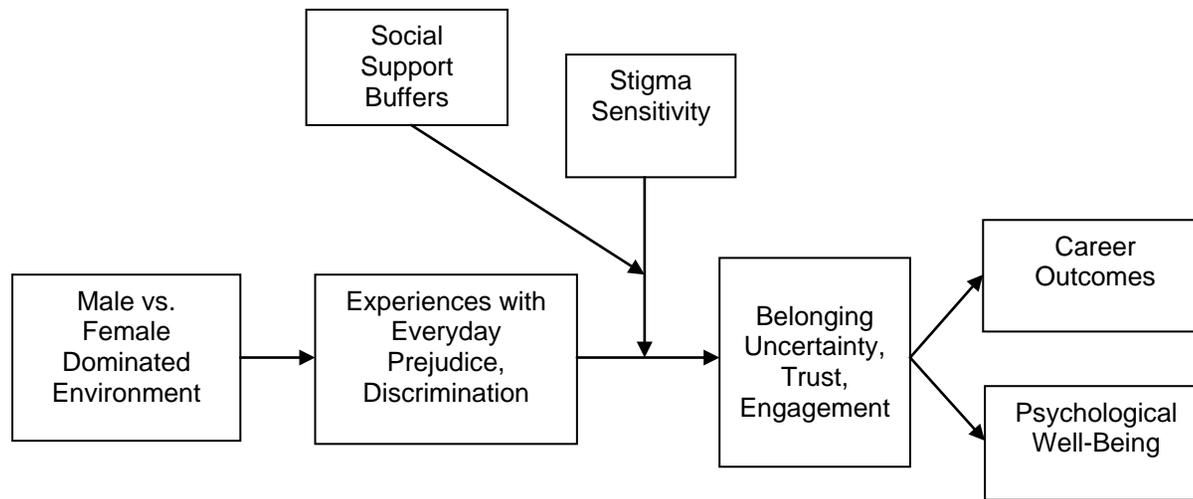


Figure 1 Ashburn-Nardo and Williams (2009): The Relationship between Belonging Uncertainty and Everyday Sexism in an Academic Setting

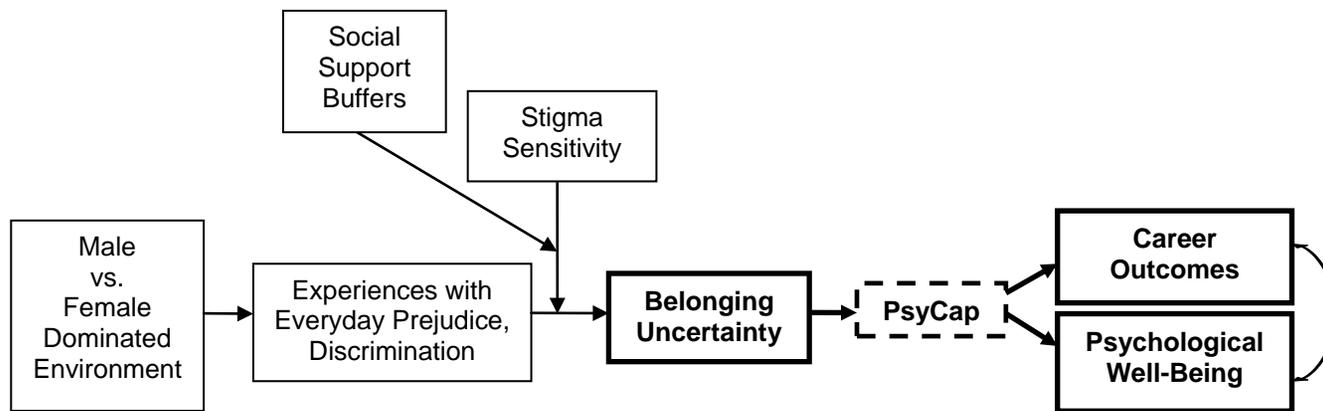


Figure 2 PsyCap as a Mediator in Ashburn-Nardo and Williams' (2009) model

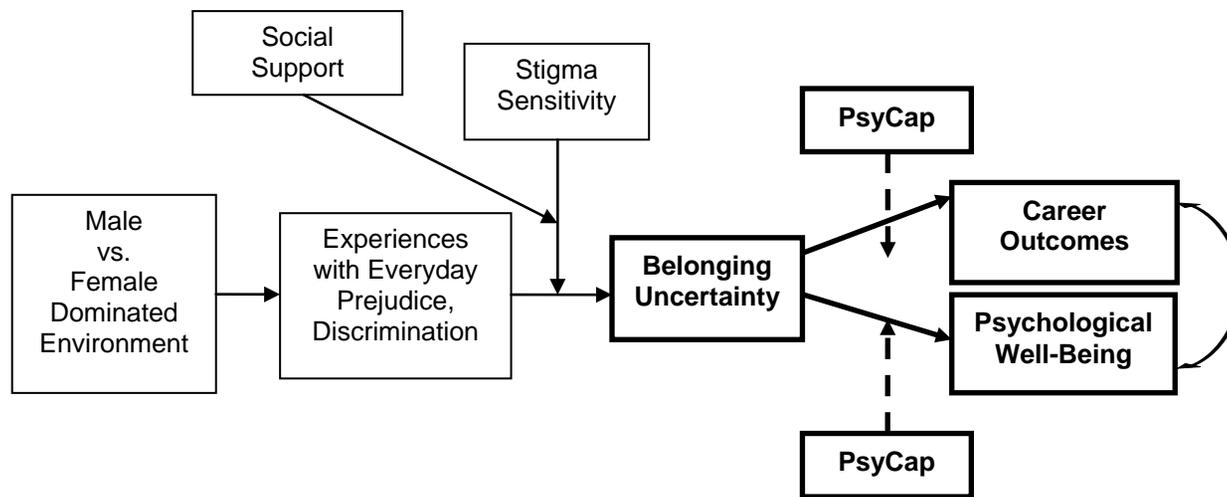


Figure 3 PsyCap as a Moderator in Ashburn-Nardo and Williams' (2009) model

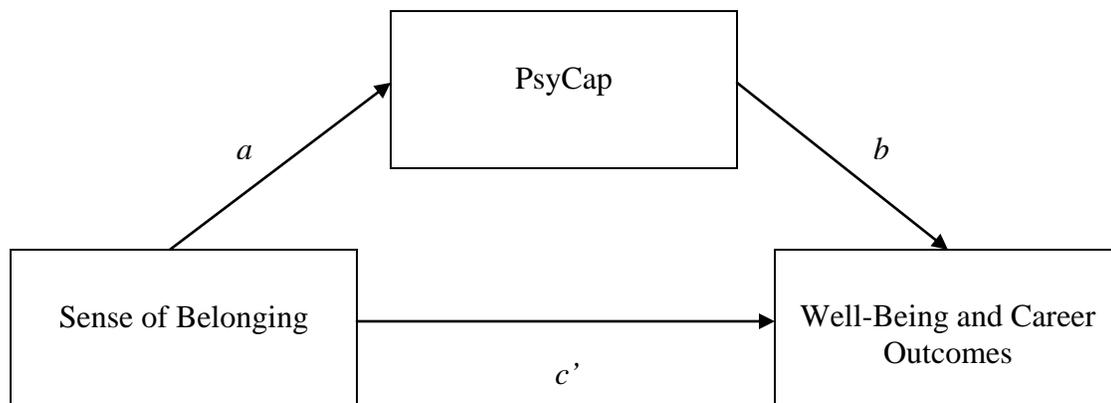


Figure 4 Mediated Model

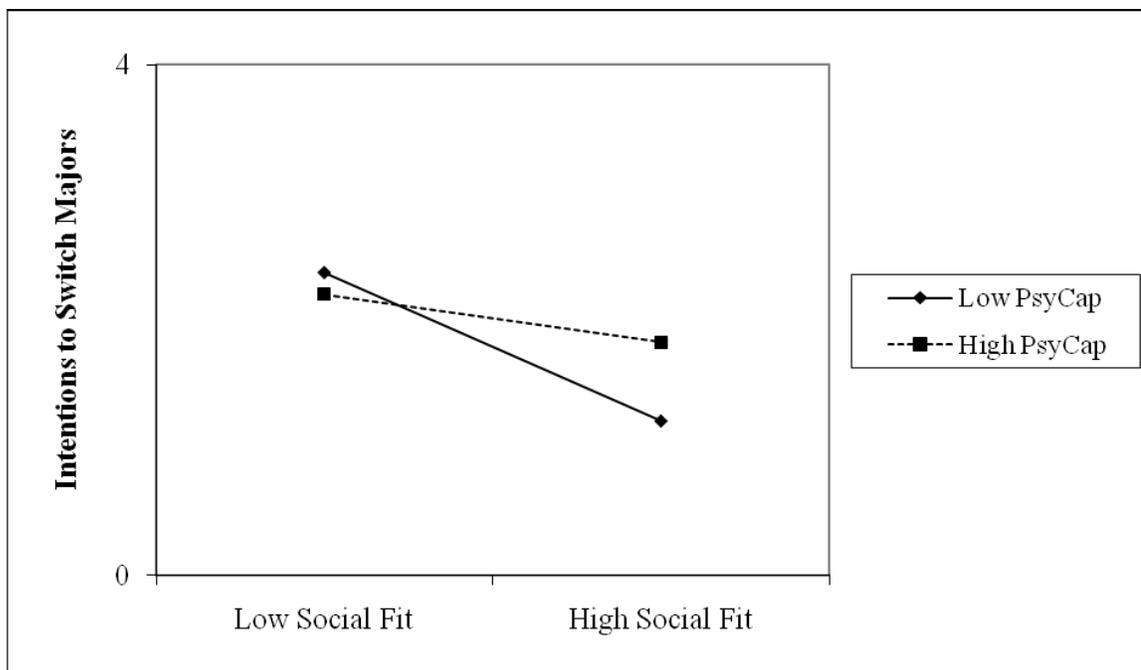


Figure 5 Interaction between Sense of Belonging and PsyCap In Relation to Participant Intentions to Switch Majors

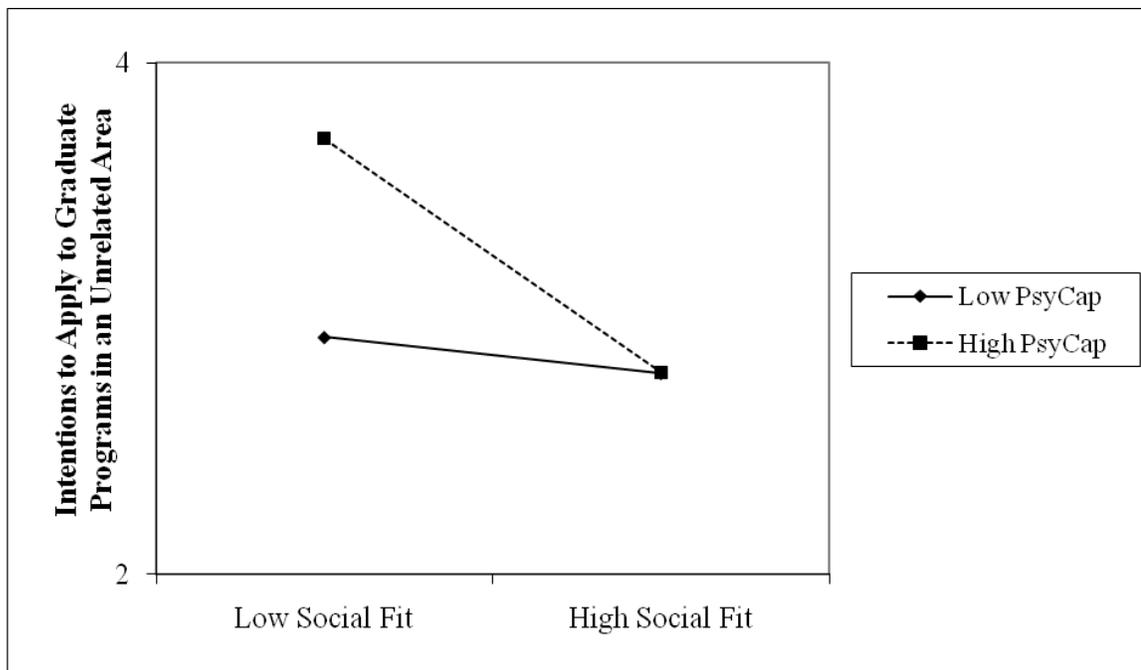


Figure 6 Interaction between Sense of Belonging and PsyCap in Relation to Participant Intentions to Apply to Graduate Programs in an Unrelated Area

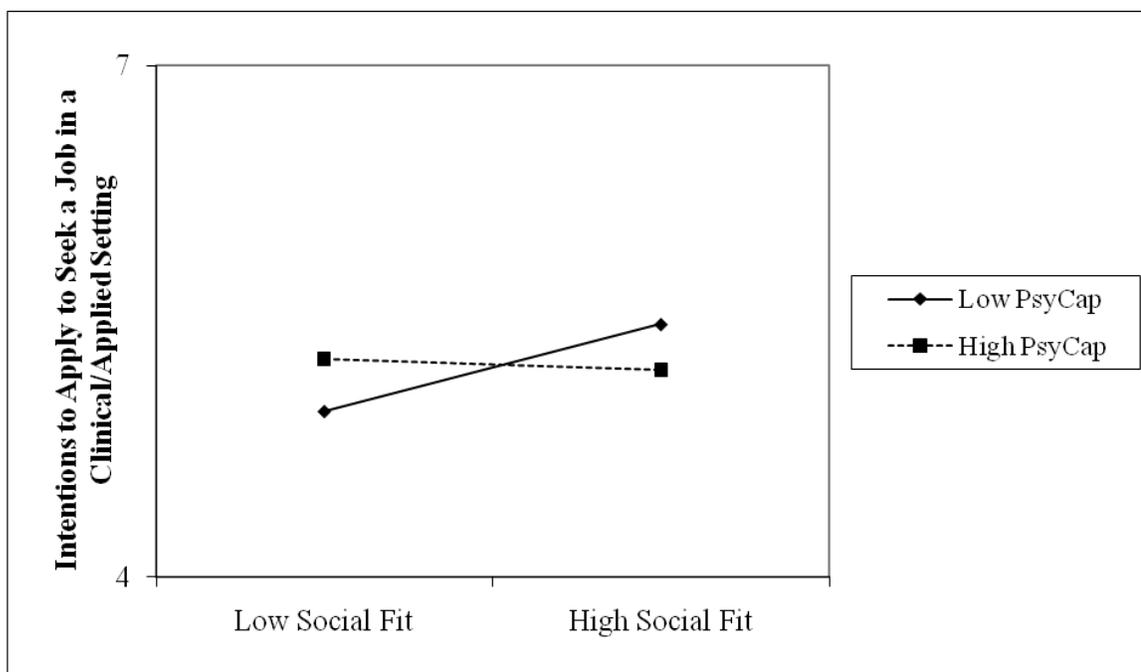


Figure 7 Interaction between Sense of Belonging and PsyCap In Relation to Participant Intentions to Seek a Job in a Clinical/Applied Setting

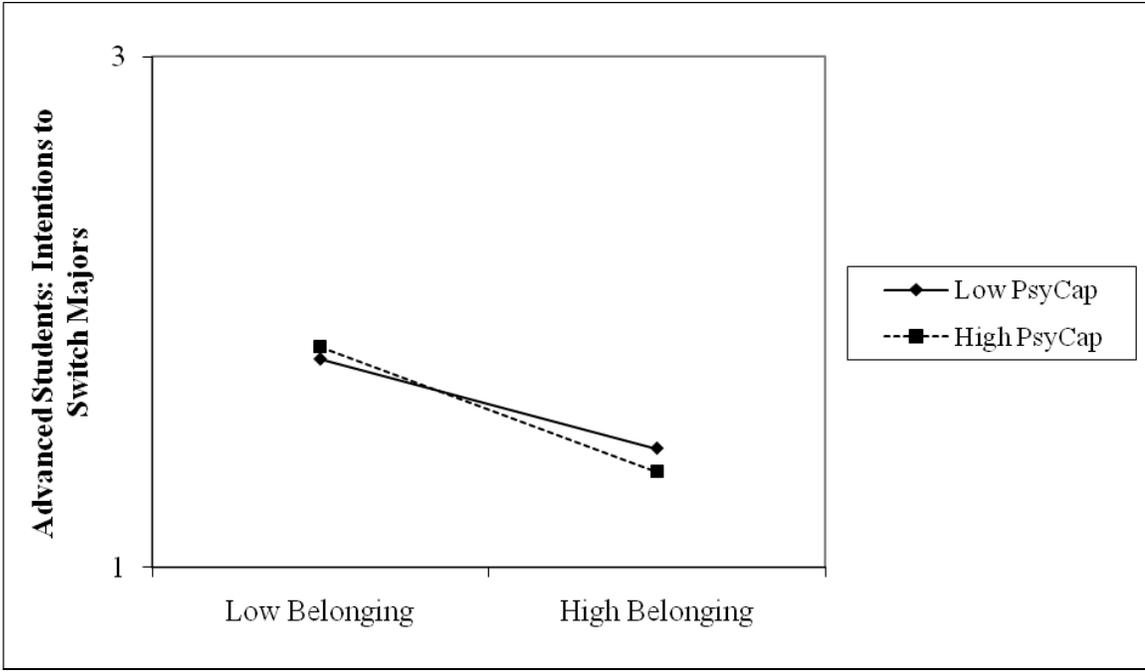
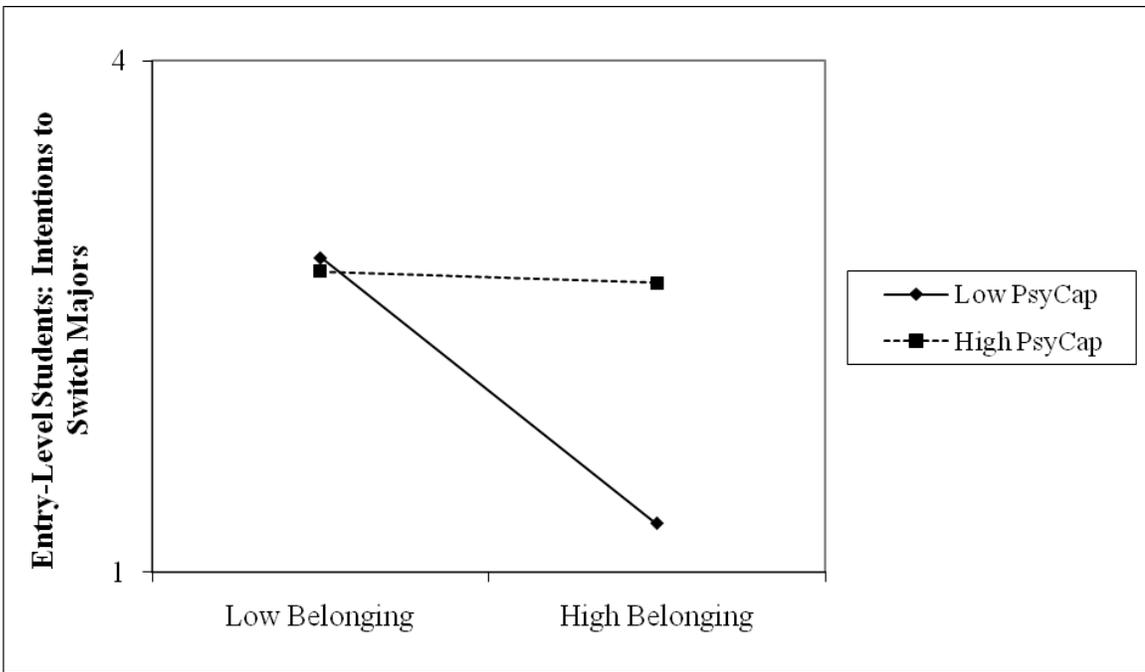


Figure 8 Interaction between Sense of Belonging and PsyCap in Relation to Intentions to Switch Majors By Group

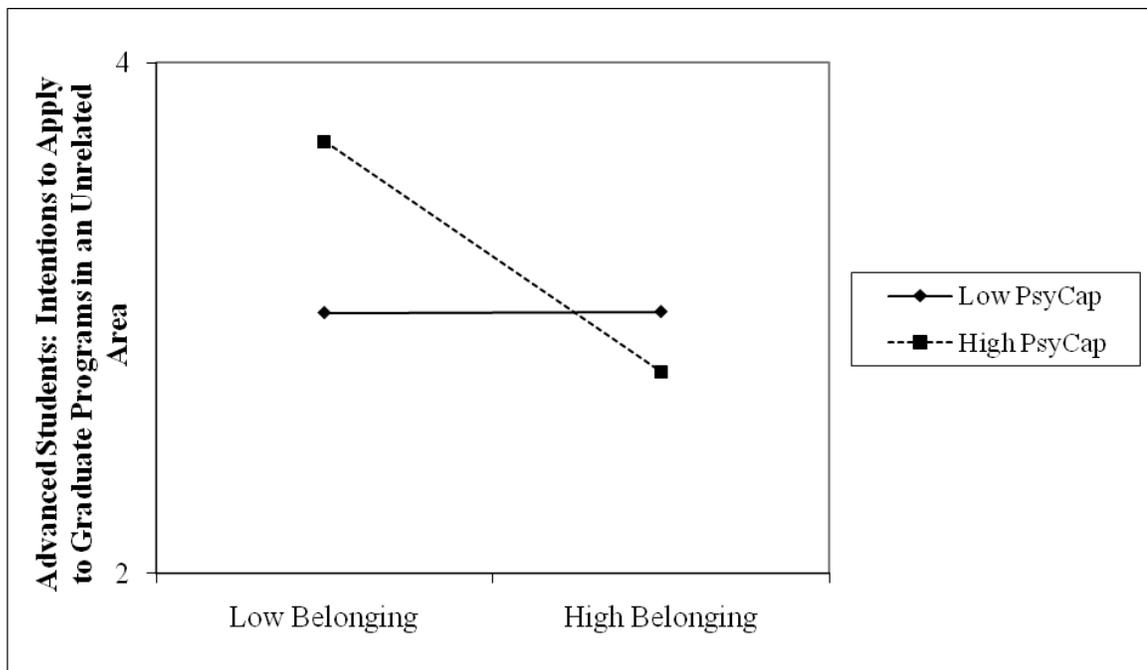
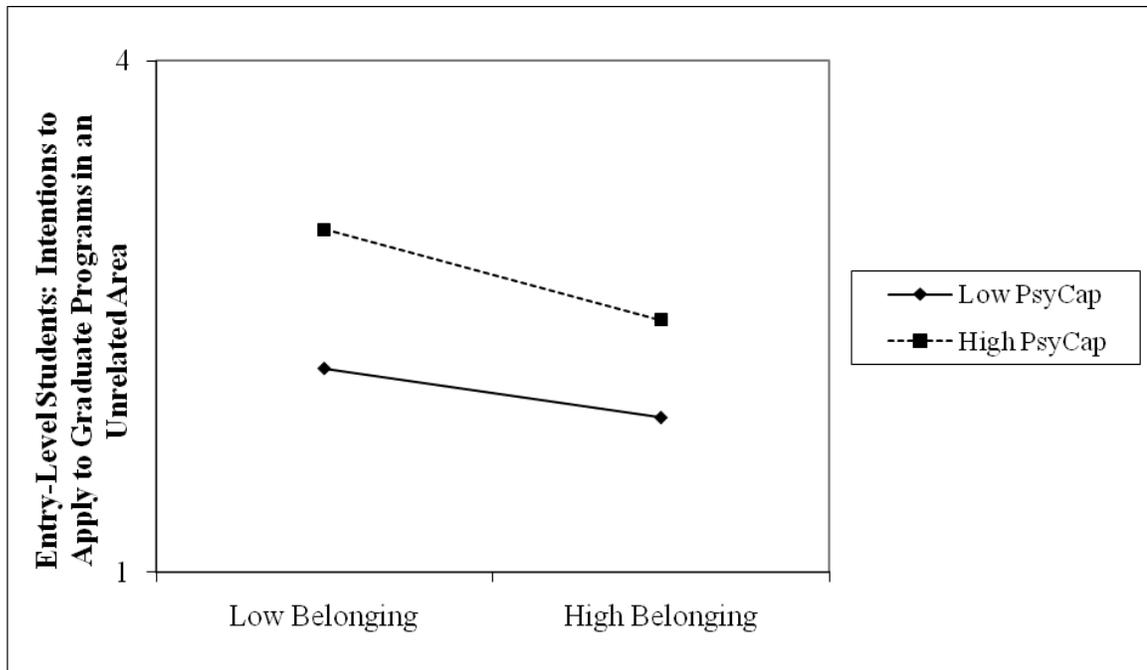


Figure 9 Interaction between Sense of Belonging and PsyCap in Relation to Intentions to Apply to Graduate Programs in an Unrelated Area by Group

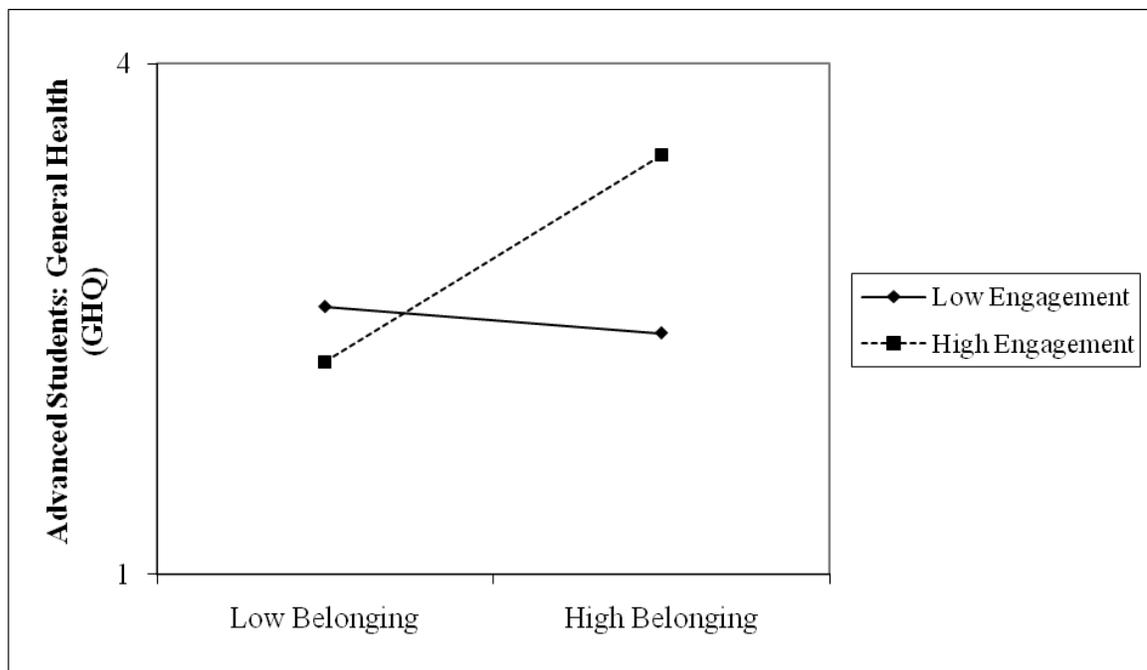
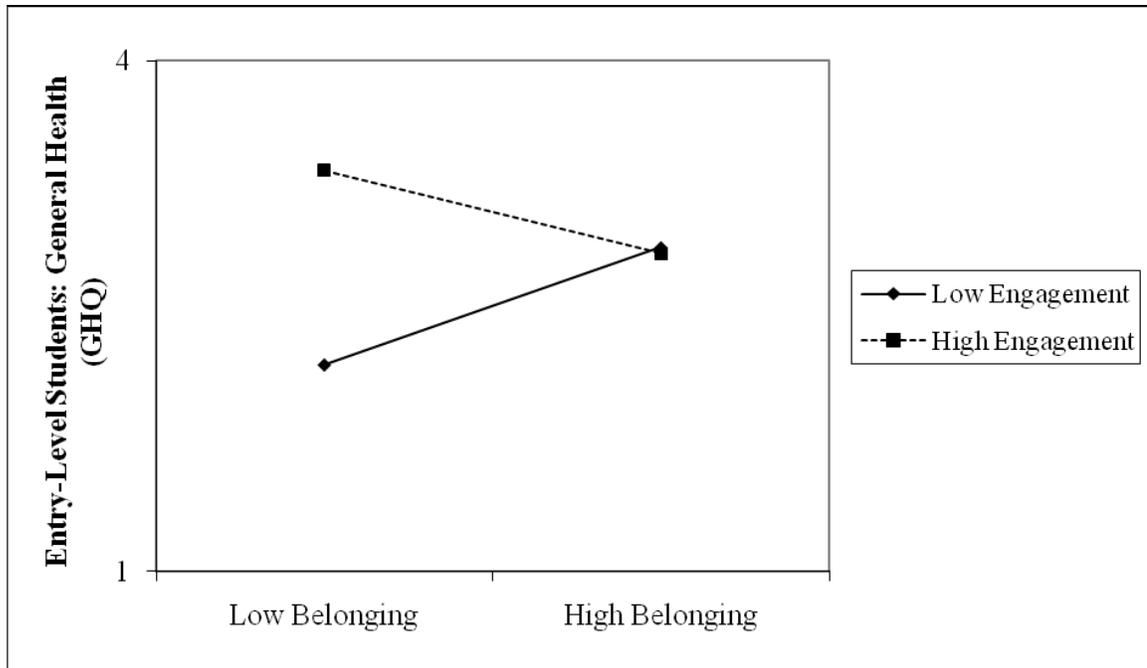


Figure 10 Interaction between Sense of Belonging and Engagement in Relation to Cognitive Psychological Well-Being (GHQ) by Group

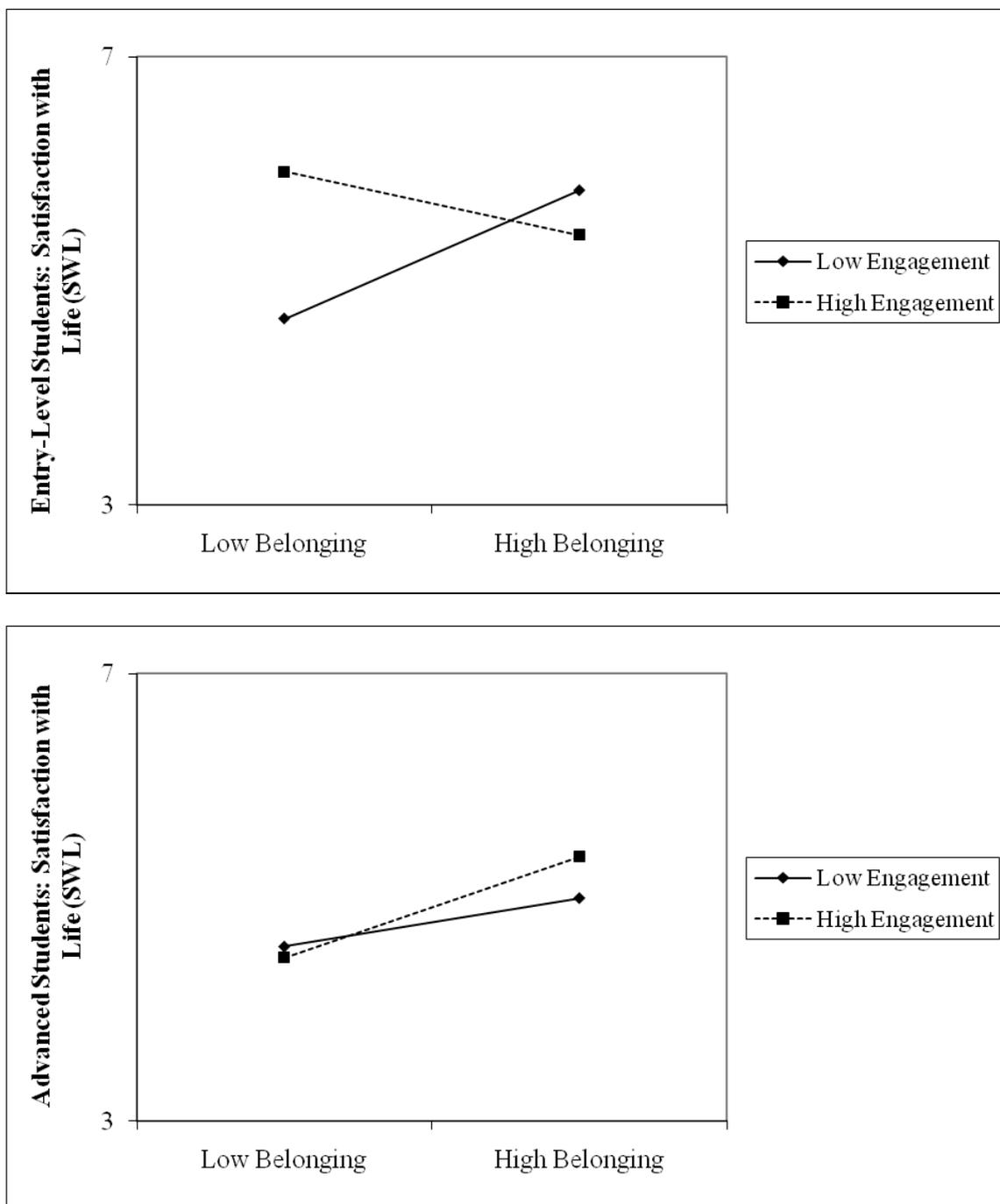


Figure 11 Interaction between Sense of Belonging and Engagement in Relation to Satisfaction With Life (SWL) by Group

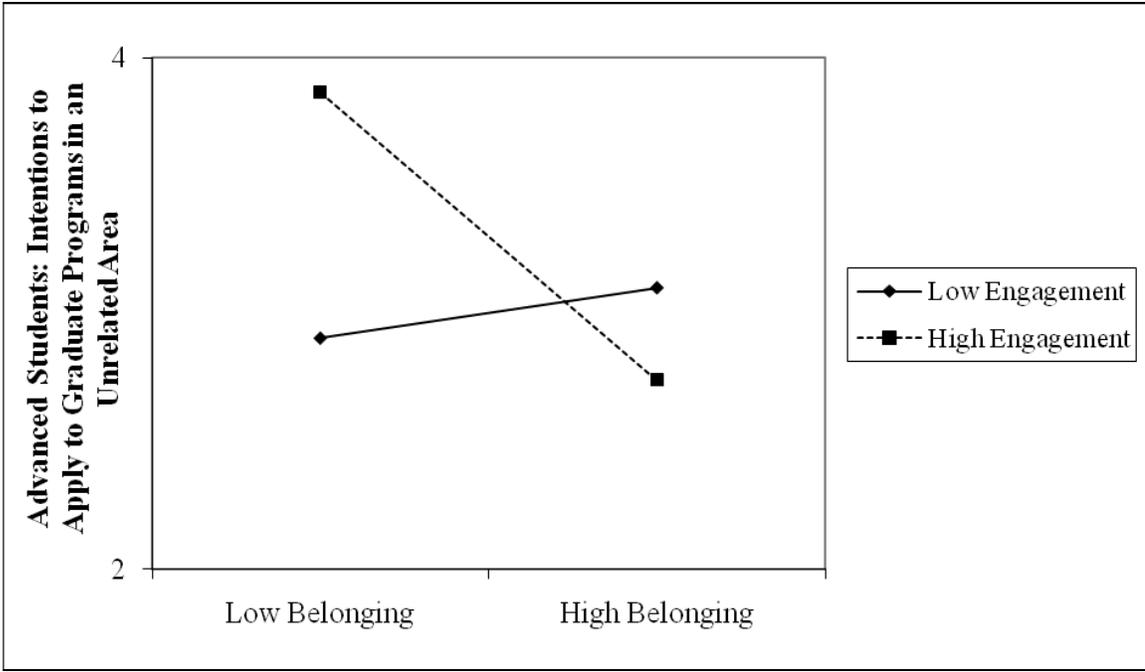
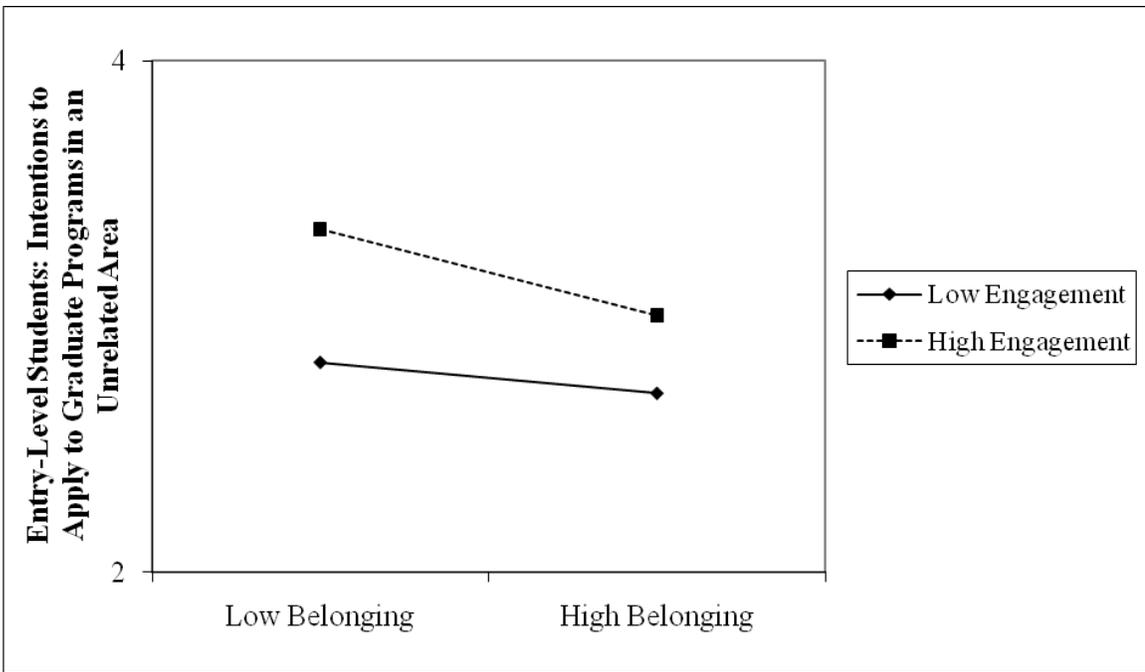


Figure 12 Interaction between Sense of Belonging and Engagement in Relation to Intentions to Apply to Graduate Programs in an Unrelated Area by Group

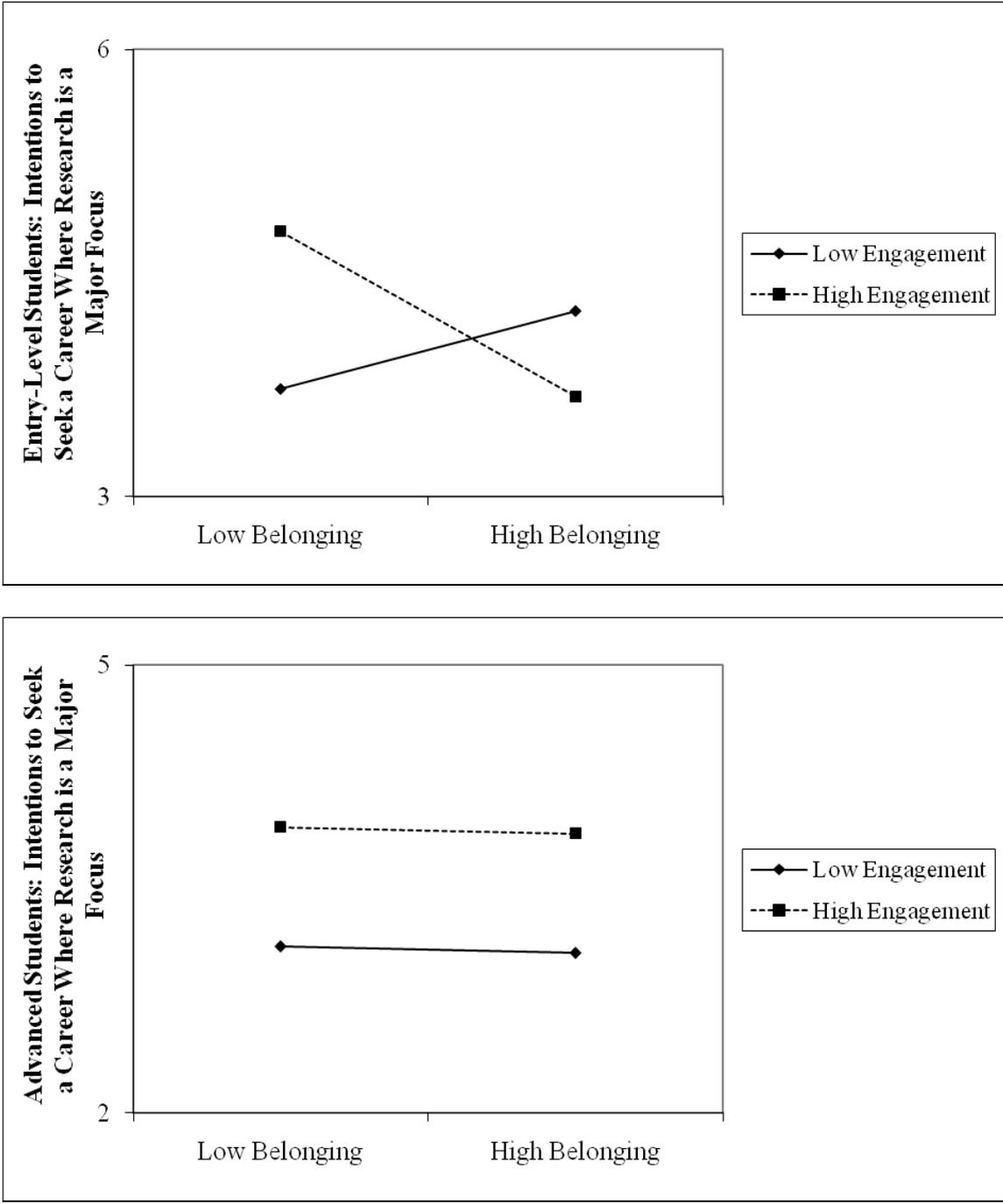


Figure 13 Interaction between Sense of Belonging and Engagement in Relation to Intentions to Seek a Career Where Research is a Major Focus by Group

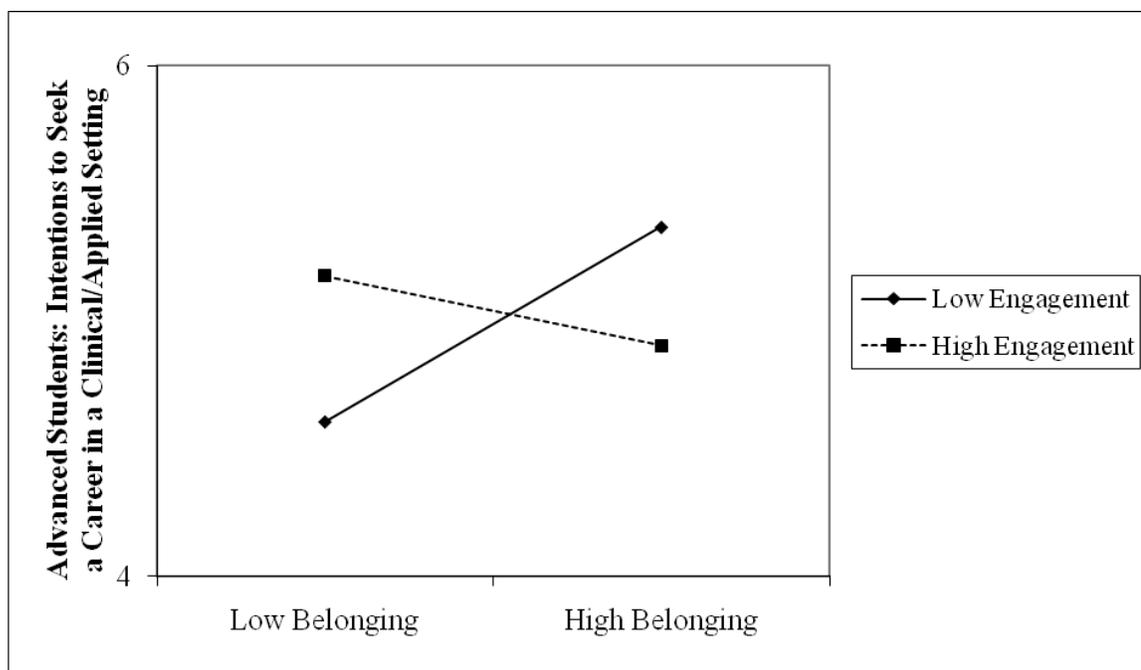
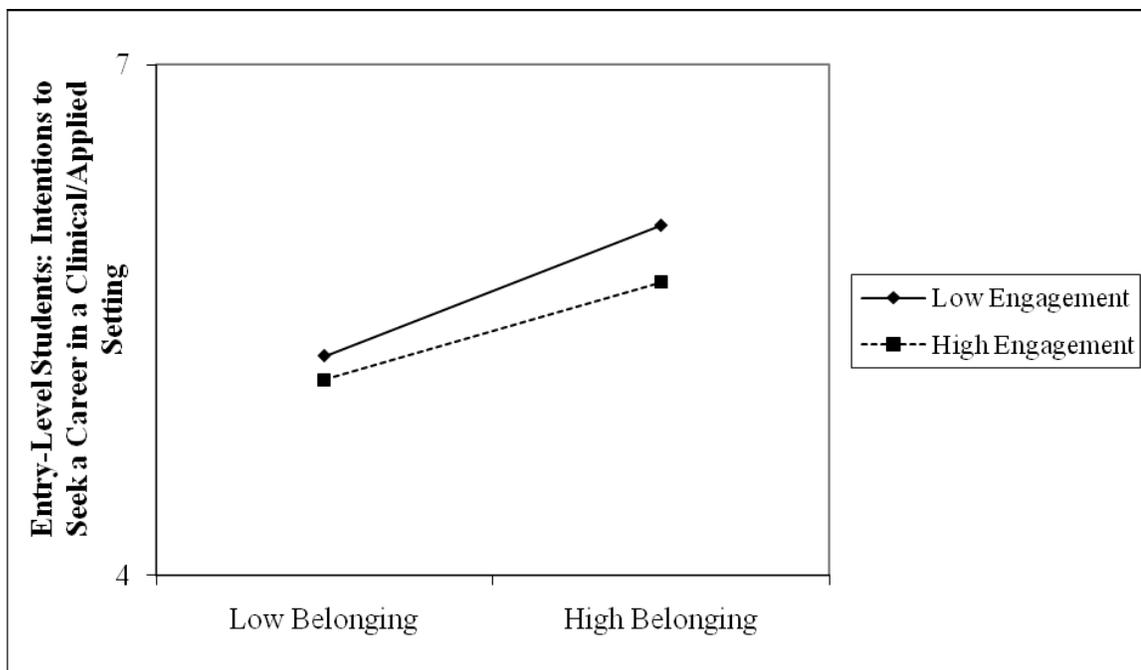


Figure 14 Interaction between Sense of Belonging and Engagement in Relation to Intentions to Seek a Job in a Clinical/Applied Setting by Group

## APPENDICES

### Appendix A: Proposal Introduction

Increasingly, women have been entering the workforce and obtaining higher levels of education. While there are strong trends in women obtaining bachelor and doctoral degrees, these numbers are not consistent with the proportion of women in *all* professional positions and *all* levels of professional positions (Liang & Billimoria, 2007). That is, of the women obtaining higher levels of education, fewer are likely to continue to graduate school in the science and math fields (Madill et al., 2007). The number of faculty and researchers in these fields is not consistent with the number of women who are earning bachelor's degrees in science and engineering. Furthermore, the proportions of women receiving doctoral degrees overall are also not representative of the proportion of women in research and faculty positions (Liang & Billimoria, 2007). For example, recent research among doctoral students across fields found that for women, only 27% of women wanted to be a professor with a research emphasis (Mason, Goulden, & Frasch, 2009). The proposed study hopes to increase our understanding of this trend by investigating factors that contribute to the lack of diversity in research and faculty positions.

#### **The Leaky Pipeline**

The idea that students, both male and female, leave fields at various points has been termed by researchers as the "leaky pipeline". The pipeline begins as students choose a major in college and ends at the level of full professor. Leaks in the pipeline are generally conceptualized in three ways: (1) those that express interest in a certain field but select other majors in college, (2) those that change majors during college, and (3) those who finish with a degree but go into other areas of study. While the leaky pipeline appears to be an issue in many fields of study, the phenomenon is especially apparent in STEM (science, technology, engineering, and mathematics) fields (Madill et al. 2007). It may also be argued that the leaks do not stop there. The fact that gender differences exist in academia and research positions, especially in STEM fields, could be an extension of such a proposed pipeline (Blickenstaff, 2005). This issue is important in the current context because women appear to "leak" out more than men.

This disproportionate leaking of women occurs at every stage of the “academic ladder” (Moyer, Salovey, & Casey-Cannon, 1999, p. 607). For instance, in science and engineering fields, women comprise roughly 50% of those obtaining bachelor’s degrees, 45% of those obtaining master’s degrees, and only 38% of those obtaining doctoral degrees (National Science Foundation, 2008). Similar patterns are also found in math with roughly half of the bachelor’s degrees being awarded to women, but only 26% of doctoral degrees (National Center for Education Statistics, 2009). Of these women who do earn doctoral degrees, the numbers continue to decline in the progression from associate to full professors. The further up the pipeline we look, the fewer women we see still present. According to Blickenstaff (2005), this is not a newly identified problem. In fact, the author notes that graduate programs have been encouraging increases in women in such fields for over twenty years. One of the main concerns is that the number of women working in these fields is not representative of either the population or of the number of women with degrees in them. Furthermore, such a lack of diversity limits the variety of viewpoints in academics.

While many researchers make reference to an academic pipeline, Dean and Fleckenstein (2007) argue that the way it is discussed is often too simplistic. There is not one entry and exit from the pipeline. Instead, there are many factors that impact whether or not ‘leaks’ occur and when they occur. In their model, they purport that there are many entry and branch points, and the actual process is not as linear as is inferred by the analogy. This argument suggests that career goals are not stable, but instead are modified to accommodate various factors that women encounter and often have to balance in their lives. For example, available resources such as people and information to aid in career planning, the acquisition of strategies and skills gained through professional activities, and experiences in school and work can have both positive and negative effects on issues related to career commitment, choice, and decisions (Madill et al., 2007). Similar sentiment is echoed by Etzkowitz and colleagues who argue that simple encouragement of women into academic and research positions has not been a sufficient fix to the lack of them present in these positions (Etzkowitz, Kemelgor, Neuschatz, Uzzi, & Alonzo, 1994). Therefore, not only is it important to understand the decision making process, it is

equally important to identify possible contributors to the issue of the leaky pipeline. Stated simply, what is stopping women from pursuing degrees in academia and research? The current study will investigate the extent to which external forces impact both undergraduate and graduate students' well-being and career intentions. Specifically, using Ashburn-Nardo and Williams (2009) model as a guide, the role that belonging uncertainty and psychological capital may have in explaining the leaky pipeline will be examined (see figure 1).

### **Ashburn-Nardo and Williams' (2009) Model**

According to Ashburn-Nardo and Williams (2009), in male dominated environments (such as STEM) women tend to have greater experiences with everyday prejudice and discrimination (e.g., Inzlicht & Ben-Zeev, 2000; Inzlicht, Aronson, Good, & McKay, 2005). Experiences with prejudice and discrimination can have detrimental effects on the psychological well-being and career outcomes of these individuals through their effect on trust, engagement, and feelings of belonging uncertainty. However, they suggest that the degree to which individuals experience negative outcomes depends on sensitivity to experiences with discrimination, or stigma sensitivity. Some people are more sensitive to or vigilant to instances of discrimination and their stigmatized status (Cohen & Garcia, 2008; Mendoza-Denton, Page-Gould, & Pietrzak, 2006). Such people tend to have greater expectations of experiencing discrimination, and thus may look to cues in their environment that confirm the expectations, or react more strongly when faced with discrimination, further reducing trust and engagement, and increasing feelings of belonging uncertainty. While stigma sensitivity serves to enhance the negative effects of discrimination on important personal and professional outcomes, the degree to which an individual has social support may serve to buffer the consequences belonging uncertainty, trust, and engagement have on academic and career outcomes such as psychological well-being. For example, recent research has found that both mentoring and cross-group friendships are two forms of social support that help to reduce the detrimental effects of discrimination (Mendoza-Denton et al., 2006).

**Outcomes in the Model: Symptoms of the Leaky Pipeline.** Psychological well-being and career outcomes, the outcomes in Ashburn-Nardo and Williams' (2007) model,

are two variables that may drastically influence many aspects of an individual's life. Further, they are also of great importance to the current study in that they are factors that may appear as leaks in the pipeline in STEM fields. Specifically, the current study will focus on the relationship between belonging uncertainty and the outcomes of psychological well-being and career outcomes.

***Psychological well-being.*** Within the work literature, psychological well-being is often described as the “overall effectiveness of an individual's psychological functioning” (e.g., Wright & Bonett, 2007, p. 143; Wright & Cropanzano, 2000, p. 85). According to Wright and Bonett (2007), literature defining psychological well-being produces three common themes. First, psychological well-being is an individual perception; the degree to which a person has high levels of psychological well-being versus low levels of psychological well-being depends on the subjective judgments of that individual. Second, people with high levels of psychological well-being tend to have more positive emotions relative to negative ones. Lastly, psychological well-being is a broad construct; it is not tied to one particular domain (e.g., work, school), but instead is more comprehensive in nature and encompasses life in general.

Much literature has established the relationship between employee well-being and important work outcomes like performance and turnover. For example, Wright and Cropanzano (2000) found that employee well-being accounted for a significant amount of variance in job performance ratings, even after controlling for age, gender, job tenure, and composite job satisfaction. Another recent study found that employees were most likely to turnover when their job satisfaction and psychological well-being were low (Wright and Bonnet, 2007). That is, when job satisfaction was low, employees with high levels of psychological well-being were less likely to turnover than those who were low in psychological well-being. Results such as these suggest that well-being may factor into employee achievement and career choices/opportunities.

***Career outcomes.*** Career outcomes can be conceptualized in many different ways ranging from more objective measures like salary to subjective measures of career success like job security. Because the current study seeks to investigate how the STEM environment influences the leaky pipeline, we will be using students as our sample. Thus,

of particular interest are the affective evaluations and goals held by these individuals that lead to academic and professional decisions and outcomes. For this reason, career outcomes will be conceptualized by career engagement, self-efficacy, and career intentions.

*Engagement.* Engagement is defined as “...a positive, fulfilling, work-related state of mind” (Schaufeli, Salanova, González-Romá, & Bakker 2001, p. 74). Engaged employees have an affective connection with their work, and thus identify with it. This connection has a motivational/energy component that allows employees to effectively deal with the demands of their career. When conceptualized in this way, the construct of engagement is opposite in nature to the construct of burnout or emotional exhaustion. In fact, it is related to a variety of health constructs including depressive symptoms, sleep disruption, and symptoms of depression (Hallberg & Schaufeli, 2006). Engaged employees/students are (1) dedicated, (2) display vigor at work/school, and (3) are absorbed in their job/studies (Schaufeli et al., 2001).

In addition to important personal and health outcomes, research has shown that, like psychological well-being, engagement is related to important career outcomes like job performance and job satisfaction (Bakker & Bal, 2010). One possible reason for this is that those who are more engaged are thought to create their own resources. In fact, a recent study found there to be a reciprocal relationship between job resources (e.g., professional development opportunities), personal resources (e.g., social support), and engagement (Xanthopoulou, Bakker, Demerouti, & Schaufeli, 2009). These relationships suggest that this construct may be important for understanding who decides to stay or leave academia. That is, the personal and professional resources generated as a result of high levels of engagement may help to facilitate advancement through the pipeline.

*Self-efficacy.* Self-efficacy refers to a judgment about one’s ability to perform to or achieve at a designated level (Wise, 2007). It can be conceptualized as either general or task-specific. In task-specific self-efficacy, these evaluations are specific to a certain task or domain (Dickerson & Taylor, 2000). The level of a person’s self-efficacy influences both how much effort is expended on a given task as well as how long that effort persists when faced with challenges. An individual’s level of self-efficacy

influences their cognitive (e.g. goal setting), motivational (e.g., goal planning and processes), and affective (e.g., experienced stress, anxiety) processes (Bandura, 1994).

Self-efficacy has been consistently linked to a variety of personal and professional outcomes like performance, skill acquisition, and coping (e.g., Gist & Mitchell, 1992, Stajkovic & Luthans, 1998; Stumpf, Brief, & Hartman, 1987). Recently, it has also been found to predict self limiting behavior in women. Specifically, level of task-specific self-efficacy predicted whether or not women chose a leadership or a group member task, with higher levels of self-efficacy predicting choice of the leadership task (Dickerson & Taylor, 2000). Furthermore, task-specific self-efficacy accounted for an additional 13% of the variance in preference for the leadership task above general self-efficacy. While this study focused on specific tasks, the findings may generalize to more broad level decisions. That is, self-efficacy that is specific to STEM fields may influence the types of academic and professional decisions individuals make.

**Antecedents in the Model: Factors that May Contribute to the Leaky Pipeline.** The conditions present in our environment work to shape the climate of our environment. These factors include people (including role models and similar others), experiences, policies, practices, and procedures. A climate is said to be ‘chilly’ when individuals within an environment are not treated equally or fairly. Even subtle differences can work to shape the climate of an environment. According to Settles, Cortina, Stewart, and Malley (2007), individual perception of climate is an important factor in understanding individual outcomes. It is perceptions of climate, the authors argue, that influence how people respond to it.

STEM fields in particular are consistently discussed as domains in which a chilly climate exists for women. One possible reason for this perception may be that science has traditionally been a male dominated field (Steele, Reisz, Williams, & Kawakami, 2007). Furthermore, not only is science thought to be a male dominated field, there is also widely held perception that women are not as good in math and science. Consequently, the stereotypes we hold may be what are creating the chilly climate in STEM fields. Interestingly, these gender stereotypes have proven to be very consistent and uniformly held across both genders (Heilman, 2001). Research even suggests that these stereotypes

are transferrable. In other words, a climate can serve to influence individual beliefs. For example, girls may hear such gender stereotypes and develop similar self-expectations for success (Steele et al., 2007). Because of the ‘chilliness’ created by an environment that may appear to devalue women’s contributions, it may result in less women choosing to pursue careers in and less women choosing to identify with STEM domains from the beginning.

For those who have already begun to pursue careers in STEM areas, such a climate may influence the *kinds* of careers that are pursued. In fact, in a recent survey of over 8,000 male and female doctoral students, negative experiences as a PhD student (46% of women, 44% of men), and feelings of isolation or alienation as a PhD student (35% of women, 31% of men) were commonly reported as reasons for moving career goals away from that of a professor with a research emphasis (Mason et al., 2009). While these experiences are reported across genders, it may be that the *causes* of such feelings and experiences may differ. For women, these negative experiences and feelings of isolation may stem from incompatibility between STEM culture and their identity as a woman.

Social psychologists suggest that people hold multiple social identities (e.g., the identity of a woman, the identity of a parent, the identity of a science major). One’s social group serves as a referent group that people identify with and thus, define themselves by. These “self definitions” serve as the basis for in-group and out-group comparisons and influence when one might feel they do or do not fit in (Hogg, Terry, & White, 1995, p. 259). One consequence of these comparisons is that people tend to pay more attention to aspects of themselves that do not fit with their environment. Additionally, people who identify with stigmatized groups are especially sensitive to issues of belonging that can be signaled by such comparisons. Identity threat occurs when an identity is engaged and perceived to be of possible negative evaluation. Because negative evaluations can threaten a group’s sense of belonging, especially when the group is of minority status in the environment, individuals who experience identity threat may also experience belonging uncertainty. In the current study, we will use the Ashburn-Nardo and Williams

(2009) model to investigate the role that belonging uncertainty has in contributing to the leaky pipeline.

***Belonging uncertainty.*** Belonging uncertainty is defined as “a global concern about the quality of one’s social ties” (Walton & Cohen, 2007, p. 83). People who experience belonging uncertainty may be concerned that they do not fit in their current environment, they may feel like they do not have strong social connections, and/or they may experience doubt as to whether or not they will be accepted by others (Walton & Cohen, 2007; Cohen & Garcia, 2008). Walton and Cohen (2007) suggest that minority members are especially susceptible to feelings of belonging uncertainty in achievement-based areas, including school and work.

Belonging uncertainty can be triggered by a variety of environmental factors/events; the only requirement is that event causes the individual to question their social ties (Walton & Cohen, 2007). Thus, feelings of belonging uncertainty can be triggered even when the person perceiving the stereotypical suggestion is not targeted by it. In fact, research suggests individual perceptions of discrimination do not need to be accurate or even be convergent with the perceptions of others to be harmful (e.g., Adams Garcia, Purdie-Vaughns & Steele, 2006; Cohen & Garcia, 2008; Settles, Cortina, Stewart, & Malley, 2007). Furthermore, results of Walton and Cohen’s (2007) study investigating belonging uncertainty suggests that feelings of belonging uncertainty arise even in situations where there is no concern of being stereotyped, no fear of negative feedback, and no test administered. In their study, Black and White undergraduate students were asked to generate a list of either eight friends, two friends, or no friends that would fit in well in the computer science department. They were then asked about their sense of fit within the department. While all participants reported difficulty in generating eight friends, only minority students reported a lesser sense of fit after the task of generating friends. This simple task was enough to cause minority students to question whether or not they belonged in the computer science major. Results such as these highlight the broad nature of the construct; even subtle cues have the potential to induce belonging uncertainty.

In a follow up study, Walton and Cohen (2007) found that for minority students, their sense of fit on any given day was related to the degree to which they experienced negative events that day (per daily diary entries of '*important events*' including academic experiences and events related to social relationships). For White students, their sense of fit was independent of hardships experienced. However, the researchers found that by communicating that most people worry about belonging on campus initially through an intervention, it reduced the degree to which minority students' sense of belonging was directly tied to experienced negative events. In fact, minority students in the experimental condition (those who experienced an intervention that addressed social belonging vs. those in a control condition who experienced an intervention that addressed social-political views) spent, on average, 1 hour and 22 minutes longer studying each day and sent three times more emails than minorities in the control condition (Walton & Cohen, 2007).

Findings similar to those found in Walton and Cohen's (2007) studies may extend to women in STEM fields. According to Adams and colleagues (2006), a lifetime of exposure to climates where women are outnumbered or are stigmatized may shape women to be more aware or vigilant to the possibility of being discriminated against (Adams et al., 2006). The identity engagement model, based on Social Identity Theory, suggests that if people feel their identity is one of a negative stereotype (and thus experience identity threat or belonging uncertainty), their identity is more likely to be engaged, and if situational cues confirm a threat to it, they are more likely to underperform (Cohen & Garcia, 2008). The differences in the way people perceive threats in their environments can influence the degree of negative effects that are experienced. If negative events are experienced, individuals may even engage in identity adaptations or protective reactions. These reactions may include domain avoidance, self-handicapping, counter stereotypical behavior, disengagement, and/or the more long term strategy of disidentification (Steele, Spencer, & Aronson 2002). Research also suggests that a person's sense of belonging is related to, among other things, their self-efficacy and cognitive engagement- two important factors influencing career outcomes (Walker & Greene, 2009). Sense of belonging even influences the type of approach students take in

learning. Among a sample of high school students, belonging predicted an additional 5% of the variance in whether or not students' adopted a mastery orientation learning approach (e.g. learning for understanding and comprehension) over both self-efficacy and perceived instrumentality (Walker & Greene, 2009).

Consequently, the reactions and decisions described above may generate leaks in the pipeline of STEM fields. However, while experiencing discrimination is psychologically harmful, individual difference factors may influence the harm experienced. Psychological capital (PsyCap) is one such factor that may influence the relationship between experienced discrimination and career outcomes, and experienced discrimination and well-being.

***Psychological capital (PsyCap).*** Psychological capital is a state-like, higher order construct emerging from the positive psychology literature (Avey, Luthans, Smith, & Palmer 2010). It refers to “an individual's positive psychological state of development that is characterized by: (1) having confidence (self-efficacy) to take on and out in the necessary effort to succeed at challenging tasks; (2) making a positive attribution (optimism) about succeeding now and in the future; (3) persevering towards goals and, when necessary, redirecting paths to goals (hope) in order to succeed; and (4) when beset by problems and adversity, sustaining and bouncing back and even beyond (resilience) to attain success” (Luthans, Avolio, Avey & Norman, 2007, p.3). Recent research has supported the utility of PsyCap as a higher order construct in predicting important work outcomes like satisfaction and performance. Specifically, results of a usefulness analysis suggest that, in general, PsyCap is more related to satisfaction and performance than each of the individual components alone (Luthans et al., 2007).

PsyCap is different from both the Big Five and Core Self Evaluations which tend to be more trait-like. Instead, it is thought to be *state-like*, and thus malleable. As a malleable construct, it can be both strengthened and weakened. This differentiates PsyCap from *positive states* (e.g, moods), which are momentary and highly changeable, and both *positive traits* (e.g. intelligence) and *trait-like* constructs (e.g. the Big Five) that are more stable and difficult to change (Luthans et al., 2007). The idea that PsyCap is a relatively enduring construct but is also developable makes it plausible to investigate as

both a mediator and moderator of the relationship between belonging uncertainty, career outcomes, and psychological well-being. The current study seeks to investigate how PsyCap fits into the Ashburn-Nardo and Williams (2009) model.

Research has established the relationship between PsyCap and important work outcomes including organizational commitment, job satisfaction, and what is of interest in the proposed study, psychological well-being (e.g., Avey et al., 2010; Luthans et al., 2007). The proposed study suggests that belonging uncertainty affects a person's psychological well-being through its relationship with PsyCap. As so, it may serve as a mediator in the Ashburn-Nardo and Williams (2009) model (see figure 2). For example, research has suggested that an individual's level of PsyCap mediates the relationship between a supportive climate and performance (Luthans, Norman, Avolio, & Avey, 2008). That is, the researchers found evidence within the work environment that a supportive climate (defined as a perception of the amount of support from those around including peers and supervisors) creates the conditions necessary to build PsyCap, which in turn positively impacts performance. These findings may also be able to generalize into the academic environment. For example, experiencing high levels of belonging uncertainty may reduce PsyCap, and in turn, psychological well-being. To our knowledge, no current studies have directly investigated the relationship between PsyCap and career outcomes such as engagement, and PsyCap and belonging uncertainty. Therefore, the proposed study will attempt to establish these links.

However, some research also suggests that the relationship between belonging uncertainty and psychological well-being could be moderated by PsyCap (see figure 3-4). We suggest that low levels of PsyCap could serve to emphasize the negative effects of discrimination on career outcomes. That is, the relationship between belonging uncertainty and career outcomes is expected to be stronger among those who also report low levels of PsyCap. Conversely, when PsyCap is higher, this relationship will be weaker. A similar relationship could be expected between belonging uncertainty, PsyCap, and psychological well-being. Feelings of belonging uncertainty may be especially harmful to well-being when PsyCap is also low.

Findings from recent research may support this relationship. For example, a recent dissertation found that high levels of optimism, one component of PsyCap, buffered the negative psychological effects of discrimination (Little, 2007). By definition, optimistic people tend to internalize positive events, but make external attributions to negative events (Luthans et al., 2007). To the extent to which discrimination is attributed to external events, a person's well-being is less harmed. Another study investigated the role that cognitive hardiness (a characteristic of people thought to be resilient, another component of PsyCap) in the stress-health relationships (Beasley, Thompson, & Davidson, 2003). Their findings suggest that, for women, cognitive hardiness buffers the stress caused by negative life events on health. Individuals who are resilient are better able to bounce back from adverse events. When faced with challenges such as discrimination or negative life events (such as those experienced in STEM fields), these individuals are able to work through the difficulty in a more proactive way.

Based on the research outlined above, along with research suggesting both the stability and malleability of PsyCap, it seems likely that PsyCap exerts influence over the relationship between belonging uncertainty and career outcomes. However, based on current supporting literature, it is difficult to determine the exact role it plays in the Ashburn-Nardo and Williams (2009) model. Thus, we seek to examine PsyCap as both a mediator and a moderator.

### **The Proposed Study**

The underrepresentation of women in research and academia is a complicated matter. It is our intent that this study offer insight into the different factors that relate to career choice. More specifically, it will seek to answer the question: how do belonging uncertainty and PsyCap influence the academic and professional outcomes of both undergraduate and graduate students in terms of career intentions and psychological well-being? According to Madill et al. (2007), career expectations held upon entering college are usually not met by the actual experience. In their study, those who came to college with a clear idea of what they wanted to do (often medicine) came across obstacles that forced them to rethink career goals. Based on the previously outlined research, and using

Ashburn-Nardo and Williams' (2009) model as a guide, I predict the following relationships:

- H1a:** The relationship between belonging uncertainty and career outcomes will be partially mediated by the level of a person's PsyCap such that high belonging uncertainty will lead to subsequent decreases in PsyCap. Low levels of PsyCap, in turn will result in greater intentions to leave academia, lower levels of engagement, and lower GPA.
- H1b:** The relationship between belonging uncertainty and career outcomes will be moderated by the level of a person's PsyCap. Specifically, the negative relationship between belonging uncertainty and career outcomes will be stronger for those with lower PsyCap than for individuals with higher PsyCap.
- H2a:** The relationship between belonging uncertainty and psychological well-being will be partially mediated by the level of a person's PsyCap such that high belonging uncertainty will lead to subsequent decreases in psychological capital. Low levels of PsyCap, in turn will result in lower levels of psychological well-being.
- H2b:** The relationship between belonging uncertainty and psychological well-being will be partially mediated by the level of a person's PsyCap. Specifically, the negative relationship between belonging uncertainty and outcomes will be stronger for those with lower PsyCap than for individuals with higher PsyCap.
- H3:** There will be a positive relationship between psychological well-being and intentions to continue in academia/research.

Appendix B: Materials

Psychological Capital (Luthans et al., 2007)

Below are statements that describe how you may think about yourself. Use the scale provided to indicate your level of agreement or disagreement with each statement.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
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Self Efficacy

1. I feel confident analyzing long-term coursework problems to find a solution.
2. I feel confident in representing my major area in meetings with faculty and other students.
3. I feel confident contributing to discussions about my major courses.
4. I feel confident helping to set targets/goals in my coursework.
5. I feel confident contacting people to discuss problems with my coursework.
6. I feel confident presenting information to a group of colleagues (e.g., faculty and other students).

Hope

1. If I should find myself in a jam in my coursework, I could think of many ways to get out of it.
2. At the present time, I am energetically pursuing my academic goals.
3. There are lots of ways around any problem in my courses.
4. Right now I see myself as being pretty successful in my courses.
5. I can think of many ways to reach my current academic goals.
6. At this time, I am meeting the academic goals that I have set for myself.

Resilience

1. When I have a setback in my courses, I have trouble recovering from it.
2. I usually manage difficulties one way or another in my courses.

3. I can be “on my own,” so to speak, at school if I have to.
4. I usually take on stressful things at school because I’ve experienced difficulty before.
5. I can get through difficult times in my coursework because I’ve experienced difficulty before.
6. I feel I can handle many things at a time while in school.

### Optimism

1. When things are uncertain for me in my coursework, I usually expect the best.
2. If something can go wrong for me coursework-wise, it usually will.
3. I always look on the bright side of things regarding my coursework.
4. I’m optimistic about what will happen to me in the future as it pertains to school.
5. In school, things work out the way I want them to.
6. I approach my coursework as if “every cloud has a silver lining.”

## Social Fit (Walton &amp; Cohen, 2005)

Answer the following questions about what your major is like for you. Indicate the extent to which you agree or disagree with each statement using the scale to the right of each statement. Please use the whole range of each scale.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
-------------------	----------	-------------------	----------------------------	----------------	-------	----------------

1. People in my major accept me.
2. I feel like an outsider in my major.
3. Other people understand more than I do about what is going on in my major/  
major department.
4. I think in the same way as do people who do well in my major.
5. It is a mystery to me how my major/major department works.
6. I feel alienated from others in my major.
7. I fit in well in my major/major department.
8. I am similar to the kind of people who succeed in my major.
9. I know what kind of people my major professors are.
10. I get along well with people in my major.
11. I belong in my major/major department.
12. I know how to do well in my major.
13. I do not know what I would need to do to make a professor in my major  
department like me.
14. I feel comfortable in my major/major department.
15. People in my major/major department like me.
16. If I wanted to, I could potentially do very well in my major.
17. People in my major/major department are a lot like me.

## Positive and Negative Affect (Watson et al., 1988)

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in scale to the right of the item. Indicate to what extent you generally feel this way. That is, in general, over the past couple of weeks, how often you feel these ways.

Very Slightly	A Little	Moderately	Quite a Bit	Extremely
---------------	----------	------------	-------------	-----------

1. Interested
2. Distressed
3. Excited
4. Upset
5. Strong
6. Guilty
7. Scared
8. Hostile
9. Enthusiastic
10. Proud
11. Irritable
12. Alert
13. Ashamed
14. Inspired
15. Nervous
16. Determined
17. Attentive
18. Jittery
19. Active
20. Afraid

## 12-Item General Health Questionnaire (Goldberg, 1972)

This scale consists of statements measuring general well-being. Read each item and then mark the appropriate answer on the scale to the right of the item. Indicate to what extent you generally feel this way. That is, indicate how your health has been in general, over the past few weeks.

Much Less Than Usual	Less Than Usual	Same As Usual Better	Better Than Usual
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Have you recently:

1. Been able to concentrate on whatever you're doing?
2. Lost much sleep over worry?
3. Felt that you are playing a useful part in things?
4. Felt capable of making decisions about things?
5. Felt constantly under strain?
6. Felt that you couldn't overcome your difficulties?
7. Been able to enjoy your normal day-to-day activities?
8. Been able to face up to your problems?
9. Been feeling unhappy and depressed?
10. Been losing confidence in yourself?
11. Been thinking of yourself as a worthless person?
12. Been feeling reasonably happy, all things considered?

## Engagement (Schaufeli et al., 2001)

Please answer the following questions about your experiences in your major. Indicate the frequency in which you feel in each of the following ways using the scale to the right of each item. Please use the whole range of each scale.

Never	Almost Never	Seldom	Sometimes	Often	Almost Always	Always
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## Vigor (VI)

1. When I get up in the morning, I feel like going to class.
2. When I'm doing my work as a student, I feel bursting with energy.
3. As far as my studies are concerned I always persevere, even when things do not go well.
4. I can continue studying for very long periods at a time.
5. I am very resilient, mentally, as far as my studies are concerned.
6. I feel strong and vigorous when I'm studying or going to class.

## Dedication

1. To me, my studies are challenging.
2. My study inspires me.
3. I am enthusiastic about my studies.
4. I am proud of my studies.
5. I find my studies full of meaning and purpose.

## Absorption (AB)

1. When I am studying, I forget everything else around me.
2. Time flies when I am studying.
3. I get carried away when I am studying.
4. It is difficult to detach myself from my studies.
5. I am immersed in my studies.
6. I feel happy when I am studying intensely.

## Satisfaction with Life (SWL) Scale (Deiner et al. 1985)

Below are five statements that you may agree or disagree with. Indicate your agreement with each item by marking the appropriate response on the scale to the right of each item. Please be open and honest in your responding.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
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1. In most ways my life is close to ideal.
2. The conditions of my life are excellent.
3. I am satisfied with my life.
4. So far I have gotten the important things I want in life.
5. If I could live my life over, I would change almost nothing.

## Intentions

The following items are intended to help us gain a better understanding about your plans for the future. Read each item and indicate the extent to which you agree or disagree with each statement by marking the appropriate answer on the scale to the right of each item. Please use the whole range of each scale.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
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### Intentions to Stay and Complete Degree

1. I intend to complete my current major.
2. I intend to switch my major.

### Intentions to Seek Graduate Training

3. I intend to apply to graduate programs in my current major or a related major.
4. I intend to apply to graduate programs in an unrelated area to my current major.

### Intentions to Enter into a Research/Academic Setting

5. I intend to seek a job where research is a major focus.
6. I intend to seek a job in a clinical/applied setting.

## Demographics

1. Sex (circle one): Female/Male
2. Age: \_\_\_\_ Years
3. Ethnicity (check one):  
 Hispanic or Latina  
 Not Hispanic or Latina
4. Race (check one):  
 American Indian or Alaska Native  
 Asian  
 Native Hawaiian or Other Pacific Islander  
 Black or African American  
 White  
 Other (please specify : \_\_\_\_\_)
5. Level in school:  
 Freshman  
 Sophomore  
 Junior  
 Senior
6. Number of courses taken so far in your **major**: \_\_\_\_ Courses
7. Number of courses taken so far **total**: \_\_\_\_ Courses
8. Major/Field of Study (check the one that most closely matches):  
 Biology  
 Biotechnology  
 Chemistry  
 Computer and Information Science  
 Environmental Science  
 Forensic and Investigative Sciences  
 Geology  
 Interdisciplinary Studies  
 Mathematics

\_\_\_ Physics

\_\_\_ Psychology

9. Grade point average: \_\_\_

The following questions will help us to match your responses now to your responses later in the semester while keeping your identity anonymous.

10. What is the name of the street you grew up on?

11. What is the name of your favorite teacher?