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Testing the Fit of a Model of Faculty Departure Intentions for Women Faculty in STEM and Non-STEM Disciplines

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I am submitting herewith a dissertation written by Amanda Marie Blakewood entitled "Testing the Fit of a Model of Faculty Departure Intentions for Women Faculty in STEM and Non-STEM Disciplines." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Higher Education Administration.

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Abstract

Much warranted attention over the past few decades has been devoted to the problem of retaining women faculty in academe, particularly in areas where they poorly represented such as in science, technology, engineering, and mathematics (STEM) fields. This study uses descriptive statistics and structural equation modeling techniques to test an existing model of general faculty departure intentions (Zhou & Volkwein, 2004) on three samples of faculty (a) women faculty, (b) women faculty in STEM, and (c) women faculty in non-STEM fields. Findings revealed that although several significant pathways to intention to leave for women faculty in STEM and in non-STEM fields were identified, the tested model is not an overall good fit of the data for any of the three samples, implying the need for new models of faculty departure intentions specifically for women in STEM and non-STEM disciplines. Implications for practice, theory, and future research are discussed.

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Chapter I

Introduction

Effectively recruiting and retaining Americans for careers in Science, Technology, Engineering, and Mathematics (STEM) fields has become an important goal for the United States as both affect the country's global competiveness as well as the pool of talent from which future generations of highly-skilled scientists can be drawn. To be sure, some fear that the United States will lose its edge on science and manufacturing to countries like China or India who are racing to train highly qualified scientists and technicians (Brainard, 2008). This fear may be justified as the United States ranked only 16^{th} of 30 developed nations on an international scientific-literacy exam administered to high school students (Schmidt, 2007). To ensure that the United States is competitive in the global economy it is important to utilize all potential talent in the STEM pool. Unfortunately, however, statistics suggest that there are several groups, such as women and people of color, who are currently underrepresented in STEM areas (National Science Foundation, 2006a; 2006b). Thus, for the United States to effectively maximize its potential in STEM and remain a relevant competitor in the global market, it is critical to focus specific attention on recruiting and retaining currently underrepresented groups into STEM fields.

Women constitute one group in particular, that warrants special attention, as it is well known that despite a similar talent and disposition for STEM disciplines as men, women are still underrepresented in these areas. For instance, although males and females demonstrate similar interest in and aptitude for math and science in elementary school (Orenstein, 1994; Pajares & Miller, 1994), by the end of high school males tend to have taken more higher-level math and science courses and outperform women on standardized tests of mathematical competencies (Benbow & Stanley, 1983; Tyson, Lee, Borman, & Hanson, 2007). Furthermore, even women who complete higher-level math and science courses in high school and score well on standardized mathematics exams are still less likely to pursue a STEM major in college than males with the same qualifications and preparation (Tyson et al., 2007).

At the collegiate level, of those who pursue a major in STEM, women's representation is skewed in terms of discipline. For instance, statistics from the National Science Foundation indicate that in 2006 women were well represented among those who earned bachelor's degrees in the biological and agricultural sciences (60%), yet earned significantly fewer degrees in both mathematics and computer sciences (27%), as well as in engineering (19%). Moreover, the number of women earning degrees in STEM declines as they move through the educational pipeline, a phenomenon referred to metaphorically as the "leaky pipeline". While 51% of all bachelor's degrees in science and engineering are earned by women, only 45% of masters degrees and 39% of doctorates in these fields are earned by women, compared to 61% of bachelor's degrees, 63% of masters degrees and 58% of doctorates earned by women in other fields (NSF, 2006a; 2006b). In other words, women students' representation in STEM fields declines as they move up the educational ladder, despite the fact that advanced degrees are increasingly the license for employment in STEM professions.

Perhaps a consequence of the leaky educational pipeline, women are also disproportionately represented in all types of employment in STEM fields. Women in STEM professions, including those in academia, continue to be underrepresented especially in the upper echelons. For instance, within the science and engineering industry, doctoral-level women are less likely to be managers than men (NSF/SRS, 2004). Additionally, those who are in upper-level positions tend to have higher attrition rates than men (Rayman & Jackson, 1996; Stolte-Heiskanes, 1991). The same is true within the academy, as women are best represented at the lower faculty ranks. In 2003, women accounted for 51.1% of adjunct faculty or lecturers, 34% of assistant professors, 32.9% of associate professors, and only 17.7% of full professors (NSF, 2003). Moreover, the majority of women tend to be clustered in the life sciences, with very few women in the "hard" science or engineering fields (Kulis, Sicotte, & Collins, 2002; Nelson & Rogers, 2005). For example, in 2003, women held 37.1% of faculty positions in the biological/life sciences, but merely 11.9% of faculty positions in engineering (NSF, 2003). The problem of low representation of women faculty in STEM fields is exacerbated by relatively high levels of attrition. Data obtained from the NSF Survey of Doctoral Recipients (1995-2003) indicate that with the exception of retiring, women were significantly more likely to leave their STEM faculty positions than were men for both voluntary and involuntary reasons. Moreover, female STEM faculty members were 40% more likely than their male counterparts to leave the tenure track and assume an adjunct position.

In STEM disciplines, female faculty departure consequences are particularly problematic considering women are so few in number. That is, losing women in fields where they are already disproportionately represented adds to problems associated with general faculty departure and may include loss of intellectual capital and trained women, fewer mentors for women and others who are advancing through the STEM pipeline, diminished morale among those who remain at the institution, diminished reputations of the institution, and costly replacement searches (Ehrenberg, Kasper, & Rees, 1991; Liang & Bilimoria, 2007; Mobley, 1982; Price, 1977).

Given the high costs of faculty departure, several scholars have developed models to explain faculty departure intentions (Smart, 1990; Matier, 1990; Mobley, 1982; Zhou & Volkwein, 2004). Expanding upon and integrating previous models of employee turnover and faculty turnover intentions, Zhou and Volkwein (2004) proposed a comprehensive framework for studying faculty departure intentions. Their model integrates previous work on faculty departure intentions and additionally uses a large database to study a national population of faculty. While their model includes gender and academic discipline variables, it consolidates these variables and does not allow for disaggregating the data by discipline. Thus, it is not possible to determine whether or not there are departure intention differences among female faculty by discipline, in particular, female faculty in STEM fields. Considering our knowledge of issues facing women faculty in STEM fields, it is not unreasonable to assume that this sub-group of faculty might have different experiences, not only from males, but also from female faculty members in fields where women are better represented, such as the humanities and social sciences (NSF, 2006a; 2006b). Despite this gap, only one study has examined faculty departure intentions for women in STEM fields. Using the National Study of Postsecondary Faculty (NSOPF:99) data, Xu (2008b) conducted multiple regression analyses to study factors related to faculty departure intentions for women in STEM. Xu's contribution to the literature is important, as she is the first to look at faculty departure intentions of women in STEM disciplines, and to identify factors relative to their departure intentions. At the same time, while providing an important beginning for the study of female faculty departure intentions in STEM, her study does not employ causal analysis modeling techniques (SEM) which enable a more in-depth understanding of variable relationships and pathways needed to grasp the complexities of faculty departure intentions, nor does she compare her findings about women in STEM to those in other disciplines to determine if these findings are unique to STEM faculty or characteristic of female faculty as a whole.

The present study seeks to address the limitations of both Xu (2008b) and Zhou and Volkwein (2004), as well as expand upon the limited literature available on faculty departure intentions of women. This will be accomplished by using Zhou and Volkwein's (2004) model of faculty departure intentions to compare the model's fit for women in STEM with those in non-STEM disciplines. The use of the model in this way will provide a deeper, more nuanced understanding of factors contributing to female faculty intention to leave in STEM, and examine whether women in STEM differ from female faculty in non-STEM disciplines.

Statement of the Problem

Global competiveness demands that the U.S. continue to produce highly skilled mathematicians and scientists to keep up with increasingly growing counties such as China and India. To do so it is necessary for the U.S. to utilize all available talent in the STEM disciplines. However, unfortunately several groups, including women, remain underrepresented in STEM areas. Although women comprise over half of students enrolled in college, their participation in STEM disciplines declines as they move through the educational pipeline. Thus, departure of female faculty in STEM fields is particularly problematic considering there are so few in number to begin with. To be sure, losing any faculty regardless of gender or discipline is undesirable as the loss is fraught with consequences for the individual as well as for the institution. To this end, several scholars have created models which aim to understand and explain faculty departure intentions in an effort to inform practice and policy and decrease the likelihood of faculty intending to leave their academic position. Still, though it is known that retention efforts of women in STEM disciplines may need to be a priority, very little is known about factors that contribute to this group of women's intentions to leave, nor is it known whether or not they are indeed different from women faculty in other disciplines where they are better represented. This study is designed to address these questions.

Purpose of the Study

The purpose of this study is to test the relationships between variables in Zhou and Volkwein's (2004) model of faculty departure intentions and determine if the model "fits" departure intentions for women faculty in STEM and non-STEM fields.

Research Questions

Specifically, the study will address the following research questions:

1. What are the relationships between the constructs and variables[1] presented in Zhou and Volkwein's (2004) model of faculty departure intentions and intention to leave for women faculty members in STEM and non-STEM fields?
2. Does the statistical model demonstrate better predictive validity for female faculty in STEM or non-STEM fields?

Theoretical Framework

Zhou and Volkwein's (2004) faculty departure intentions model provided the theoretical framework guiding the study. Building on earlier models posited by Smart (1990) and Matier (1990), Zhou and Volkwein (2004) proposed an integrated model which combines both internal and external factors contributing to faculty intention to leave their current job. This model consists of four main elements: (a) current institution—internal factors, (b) outside institution—

[1] The terms constructs and variables are used in accordance with Zhou and Volkwein's (2004) verbage and reflect the model design.

external factors, (c) job satisfaction, and (d) intent to leave. Borrowing from Matier's (1990) model of faculty turnover, Zhou and Volkwein suggest that internal factors can be organized into three groups: (a) individual and family characteristics (e.g., gender, ethnicity, family/marital status), (b) organizational characteristics (e.g., institutional type, institutional size, unionization), and (c) work experiences (e.g., academic rank, tenure status, productivity). They argue that these factors can influence intention to leave by exerting a 'push' force or pressure for an individual to consider leaving their current job. On the other hand, external factors including: (a) external job market, (b) extrinsic rewards, (c) research opportunities, (d) teaching opportunities, and (e) family considerations might exert a 'pull' force leading to faculty departure intentions. In other words, dissatisfaction with factors associated with a faculty member's current job could 'push' them to consider leaving, whereas extrinsic opportunities or situations could alternatively 'pull' faculty from their current job. Additionally, Zhou and Volkwein theorized that job satisfaction mediated the relationship between internal factors and intention to leave. That is, current institution-internal factors influence job satisfaction, which in turn influences intention to leave. The four main elements of Zhou and Volkwein's model (i.e., intention to leave, job satisfaction, internal factors and external factors) are described in more detail in chapter 2.

The present study was influenced by the model in several ways. First, the framework was influential in understanding the problem of departure intentions of faculty women in STEM, and conceptualizing a study to examine it. Second, the construction of the study was built around the Zhou and Volkwein model of faculty departure intentions to provide a consistent framework with which to examine faculty departure intentions for women in STEM and non-STEM fields. Finally, the model was used as a guide to variable entry and block construction in data analysis.

Significance of the Study

The present study has significance for practice, research and theory. These are discussed in more detail below.

Significance for Practice

Findings from this study can benefit several constituents at the institutional, departmental, and individual levels. First, results from the proposed study have important implications for those who shape practice and policy at the institutional level including department heads, deans, and provosts. As previously mentioned, faculty departure can lead to a number of negative consequences for the institution (e.g., costly replacement searches, loss of intellectual capital, and diminished reputation of the institution). Thus, gaining a better understanding of factors that affect faculty departure intentions for those in STEM and non-STEM may help department heads and deans develop new practices for retaining them, thereby reducing the loss of time, talent, and resources used to hire new faculty.

Furthermore, part of this study will test the applicability of Zhou and Volkwein's (2004) model for women faculty in STEM fields – fields where they are poorly represented. By understanding the factors associated with their intention to leave, campus administrators and department leaders are better positioned to reduce women's intentions to leave their current job, thereby improving their representation in the STEM pipeline, particularly among the faculty ranks.

Finally, on an individual level, findings from this study can be beneficial to female faculty in STEM fields. First, if more accommodating practices and policies derive from the research, then female faculty will be direct beneficiaries of these changes. Moreover, better informed practice and policies may begin to shape department climates and cultures so that more women are retained in STEM disciplines. If this is so, increased numbers of women in STEM can contribute to increased numbers of recruits from future generations into STEM fields.

In short, findings from this study can be beneficial to several educational stakeholders including institutions of higher education, administrators who shape practice and policy at both the institutional and departmental levels, and women in STEM disciplines who are affected by institutional and departmental climates.

Significance for Research

Findings from this study might also be important to inform future research. The purpose of this study is to test the model fit for female faculty in STEM and non-STEM disciplines. Future studies might test the model's predictive validity for other subgroups of faculty including faculty of color, parental status (faculty with children), or faculty in various types of institutions (e.g. community colleges, teaching universities). Moreover, while the present study focuses on intention to leave, future studies might study actual departure decisions for female faculty in STEM fields. Studies such as these would contribute to the current understanding of faculty turnover and help reduce the likelihood of voluntary departure.

Significance for Theory

Finally, findings from this study could be used to shape future theory. Currently, the theoretical models of faculty departure intentions focus on male and female faculty across disciplines. Thus, they are limited in their ability to predict outcomes for various sub-groups of faculty members. In this study, Zhou and Volkwein's (2004) model of faculty departure intentions is used to predict turnover intentions for female faculty in STEM and non-STEM disciplines. By understanding if the current models of faculty departure intentions demonstrate predictive validity for different groups of faculty, including women in STEM fields, researchers can begin to apply new information to add to and build more accurate theoretical models explaining turnover intentions.

Delimitations and Limitations

It is important to take note of several delimitations in the present study. First, though the study purports to explain the phenomenon of faculty departure, departure decisions are not directly measured. Instead, consistent with the approach used by previous scholars (Price, 1977; Smart, 1990; Zhou & Volkwein, 2004), intention to leave is used as a proxy for actual departure decisions. Second, though a newer wave of NSOPF data has since been released, NSOPF:99 was the last wave of the national survey to include questions on intention to leave. Thus, this study is based on the 1999 database. While somewhat dated, it is considered the most comprehensive, nationally representative sample of postsecondary faculty in the U.S. that permits investigation of intention to leave decisions. Third, a limitation of utilizing secondary data is the availability of the variables. Thus, certainly there are variables that influence faculty intention to leave that are not available in the NSOPF dataset and are therefore not included in the model. Finally, intention to leave is not separated in the data into those who change institutions and those who leave academia altogether. Theoretically, factors influencing these decisions could vary significantly, thus, if possible, these intentions should be modeled separately in future studies. Despite these delimitations, study of faculty departure intentions for various sub groups of faculty is warranted in order to gain a better understanding of and reduce the likelihood of premature turnover.

Organization of the Study

This study is presented in five chapters. Chapter One, the introduction, begins with the background and context of the study and a statement of the problem. Following these sections, the purpose of the study and research questions are proposed. An overview and description of the theoretical framework guiding the study is included, and finally, the significance of the study is discussed. In Chapter Two, a more thorough and exhaustive synthesis of relevant literature is reviewed. Chapter Three gives details about the methods and procedures used in the conduct of the study. In Chapter Four, results of the study will be presented. Finally, in Chapter Five, the findings will be discussed in relation to the existing literature. Implications for policy and practice will be proposed, and recommendations for further research will be made.

Chapter II

Faculty Departure Intentions and Women in STEM

This study examines the “fit” of a model of faculty departure intentions for faculty women in STEM as compared to those in non-STEM disciplines. To this end, this chapter reviews the literature relative to this topic. The review is organized into two major sections: (a) studies on faculty departure intentions and its conceptual underpinnings, which will include a further discussion of the theoretical framework (Zhou & Volkwein, 2004) and (b) studies on women in STEM. Taken together, these areas provide a thorough review of the research related to this study.

Faculty Departure

Employee Turnover and Intention to Leave

The research on faculty departure intentions builds upon previous research on general employee turnover. For this reason, this discussion of faculty departure intentions begins with a review of the key studies from the literature on employee turnover. Specifically, studies that directly contribute to the design of faculty departure models are included. Three studies in particular (Hertzberg, Mausner, & Snyderman, 1959; Mobley, Horner, & Hollingsworth, 1978; Porter & Steers, 1973) directly influenced and shaped subsequent studies and models of faculty departure intentions.

Herzberg’s Contribution

Herzberg, Mausner, and Snyderman (1959) sought to identify factors that contribute to employees overall productivity and efficiency at the workplace. They assumed that the more satisfied employees were with their jobs the more likely they were to be productive and remain at their current job. To test this assumption, Herzberg and his colleagues interviewed approximately 200 engineers and accountants in nine Pittsburgh plants to ascertain if employee perceptions of positive or negative experiences affected their overall feelings about their job (e.g., satisfaction) and their perceptions of their job performance. From their study they hoped to: a) establish the relationship between an employee's level of satisfaction and perception of job performance, and b) understand what experiences contribute to an employee's satisfaction level and perception of job performance. From the employees' stories, Hertzberg and colleagues found that: a) employees who were satisfied also perceived themselves to be more productive and b) the causes of employee satisfaction or dissatisfaction could be placed into one of two categories -- factors they labeled "motivator factors" and "hygiene factors." On one hand, *Motivator* factors, or intrinsic factors pertaining to the job itself (e.g., achievement, job responsibilities), predicted high levels of job satisfaction and performance. On the other hand, Hertzberg and colleagues found that positive perceptions of *Hygiene* factors, or extrinsic factors describing the job context (e.g., salary, working conditions) prevented low levels of job satisfaction and poor performance, but did not, however, cause high levels of job satisfaction or good job performance.

Hertzberg's Two Factor Theory, published in his book *The Motivation to Work,* continues to influence research on employee job satisfaction, and laid the groundwork for models of faculty departure intentions, all of which suggest that both internal and external factors contribute to job satisfaction (please refer to appendix A for Zhou and Volkwein's model of faculty departure intentions which illustrates the relationships between factors presented here) However, as seen in Zhou and Volkwein's model, job satisfaction is not the outcome of the model. Instead, in models of faculty departure intentions (e.g., Smart, 1990; Zhou & Volkwein, 2004), job satisfaction mediates the relationship between the internal and external factors identified by Hertzberg and faculty departure intentions. To this end, another important aspect of models of faculty departure intention is the connection between job satisfaction and turnover. This link was established by Porter and Steers (1973).

Though general research on employee turnover (e.g., Brayfield, & Crockett, 1955; Herzberg, Mausner, Peterson, & Capwell, 1957; Schuh, 1967; Vroom, 1964) is abundant and outside of the scope of this research, one study in particular helped shape literature on faculty departure intention and is therefore relevant to this review. Previous research in the field of employee turnover, including the studies cited, suggested that there was a relationship between job satisfaction and turnover, yet Porter and Steers (1973) argued the need for a more rigorous and comprehensive study of job satisfaction and turnover based on an analysis of existing studies. In their meta-analysis, Porter and Steers (1973) organized and critically examined research from the previous 10-12 years on factors related to turnover and job satisfaction. From their analysis they found strong consistent support for the negative relationship between job satisfaction and turnover.

Additionally, Porter and Steers (1973) found that job satisfaction was a multi-faceted construct. In other words, it was possible for employees to be satisfied with one aspect of their job and not another. From this knowledge, Porter and Steers posited that job satisfaction was a composite of factors that they grouped into four areas: (a) organization-wide factors, (b) immediate work environment factors, (c) job-related factors, and (d) personal factors. Similar to Hertzberg, Porter and Steers' work also influenced models of faculty departure intentions (e.g., Smart, 1990; Zhou & Volkwein, 2004). More specifically, based on the work of Porter and

Steers (1973), models of faculty departure intentions included several types of job satisfaction, including satisfaction with salary, job security, and autonomy to name a few.

Though Porter and Steers (1973) affirmed the relationship between job satisfaction and employee turnover, a group of prominent scholars (Mobley, Horner, & Hollingsworth, 1978) questioned if there were intermediary steps that took place between a person's level of job satisfaction and turnover. Building on the idea posited by Fishbein and Ajzen (1975) in their Theory of Reasoned Action that intentions to perform any given action will always precede the action or behavior, Mobley, Horner, and Hollingsworth (1978) applied this concept to their study on employee turnover. To do so they created and tested a heuristic model of employee turnover intended to provide an in depth understanding of the withdrawal decision process. First, Mobley and his colleagues surveyed 203 urban hospital employees on measures of: (a) job satisfaction, (b) thoughts and intentions of quitting, and (c) perceptions of ability to find another job. Then they collected departure data 47 weeks after the initial survey. This design allowed Mobley and colleagues to compare survey response data to actual departure data. Their analysis provided support for Fishbein and Ajzen's (1975) Theory of Reasoned Action and revealed that job satisfaction did not directly relate to turnover, but rather was significantly related to several intermediate steps including, (a) thinking of quitting, and (b) intentions to quit.

With groundwork in employee turnover, most notably the key studies Hertzberg et al. (1959), Porter and Steers (1973) and Mobley et al. (1978), to build upon, higher education scholars have generated a number of studies and models that aim to understand factors that contribute to faculty intention to leave or stay at their current institution. Generally, these studies can be grouped into two groups: (a) studies that examine individual factors and (b) studies that examine environmental factors. Previous studies in employee turnover indicated that study of departure is complex for any vocation, faculty included. To this end, then, the most significant contributions to the literature on faculty departure intentions have been made by scholars who developed and tested models which included a large number of variables and established direct and indirect relationships between variables (Johnsrud & Rosser, 2002; Rosser, 2004; Smart, 1990; Zhou & Volkwein, 2004). First, studies that explore the relationship of three types of internal institution factors: (a) individual and demographic characteristics, (b) academic characteristics and (c) job satisfaction to intention to leave will be examined. Second, the relationship of external institutional factors to intention to leave will be considered. Then, studies relating job satisfaction to intention to leave will be reviewed.

Internal Factors Related to Faculty Departure Intentions

A large body of research has been dedicated to examining the effect of various internal institution factors on faculty turnover and intention to leave. As Zhou and Volkwein suggest, this research can be further delineated into three groups: (a) individual and demographic characteristics, (b) academic characteristics, and (c) job satisfaction.

Individual and demographic characteristics.

Several scholars have studied the relationship of demographic factors and faculty turnover, though it is important to note that in these studies, demographic variables were usually included as control variables and thus not the variables of interest in the research (Barnes, Agago, & Coombs, 1998; Hagedorn, 1996; Johnsrud & Heck, 1994; Smart, 1990). Still, these variables are related to intention to leave and therefore noteworthy. Among demographic factors, age has been found to be the most consistent predictor of faculty turnover. That is, the younger the faculty members, the more likely they are to leave their current position (Johnsrud & Heck, 1994; Smart, 1990). Studies from the national center of education statistics corroborate these findings reporting that there is an inverse relationship between faculty age and willingness to accept a non-postsecondary job within the next three years, with younger faculty most willing to move positions (NCES, 1997).

In addition to age, race has also been studied in relationship to faculty turnover. However, findings from studies on race and faculty turnover have produced inconsistent results. On one hand, research suggests that minority faculty are less likely to earn tenure and promotion, and are therefore more likely to leave (Rausch, Ortiz, Douthitt, & Reed, 1989; Sanderson, Phua, & Herda, 1999). On the other hand, Johnsrud and Heck (1994) found that although minority faculty felt less supported by the university and less satisfied with the quality of work life, they were also less likely than their white colleagues to leave their current academic position. In sum, while race may not have a direct effect on intention to leave, when studied in relation to other variables, research indicates that race may influence turnover indirectly. Thus, it remains important to include such variables in full models of faculty turnover (Smart, 1990; Zhou & Volkwein, 2004).

Academic characteristics.

In addition to demographic factors, a large body of research has examined academic factors in relation to faculty turnover (Barnes, Agago, & Coombs, 1998; Blackburn & Havighurst, 1979; Daly & Dee, 2006; Ehrenberg, Kasper, & Rees, 1991; Johnsrud & Heck, 1994; Johnsrud & Rosser, 2002; Manger & Eikeland, 1990; Rosser, 2004; Smart, 1990; Weiler, 1985; Xu, 2008a; Xu, 2008b; Zhou & Volkwein, 2004). Specifically, several scholars have studied issues surrounding the quality of work life for faculty (Barnes et al., 1998; Daly & Dee, 2006; Johnsrud & Heck, 1994; Manger & Eikeland, 1990). For example, Barnes and her colleagues studied the effects of job-related stress on faculty intention to leave. Their study included stress variables (i.e., reward satisfaction, institutional/departmental reputation, time commitment, departmental/institutional influence and student interaction), as well as academic and demographic factors (academic discipline, tenure status, and gender). In their national study of 3,070 full time tenure track faculty representing 306 institutions, Barnes and her colleagues analyzed data from the *National Survey of American Professorate* conducted by the Carnegie Foundation for the Advancement of Teaching. A series of hierarchical regression analyses indicated that their model, including all variables studied, explained 25% of the variance in intention to leave academia. Their results indicated that several types of job-related stresses, including stress to earn tenure and stress on time demands were significantly related to intention to leave for faculty.

Similarly, Manger and Eikeland (1990) used multiple regression techniques to identify factors contributing to intention to leave for Norwegian faculty. Manger and Eikeland collected data though a survey of 601 lecturers and full time faculty at a large Norwegian university. Survey questions included items on favorable and unfavorable conditions at the university as well as aspects of their private life and whether or not these conditions affected the intention to leave. Data were analyzed to determine the relationship between the dependent variable, intention to leave, and thirteen independent variables or factors. In total, the regression model accounted for 24% of the variance in intention to leave. Results from their study indicated that faculty relationships with colleagues and job satisfaction were the two strongest predictors of turnover intention. That is, faculty who perceived they had good relationships with their colleagues and who also reported being satisfied with their job were less likely to report intentions to leave.

Additionally, Daly and Dee's (2006) study of urban faculty provided further support for the importance of studying quality of work life variables with regard to faculty intention to leave. Daly and Dee built their study based on the recommendation from Zhou and Volkwein (2004) that work environment and its relationship to intention to leave needed to be further explored. Thus, the purpose of their study was to advance understanding of work environment and to examine relationships between work environment factors and intention to leave. To collect their data, Daly and Dee sent questionnaires to a random sample of 1500 faculty at 15 randomly selected public urban institutions across the United States. Then, they conducted a path analysis to analyze their data. Overall their model, which included a number of background, structural, psychological, and environmental variables, explained 53% of the variance in intention to leave. Specifically, they found that measures of autonomy, communication, openness, disruptive justice, job satisfaction, and organizational commitment had positive direct relations to intention to leave, while role conflict, workload, and job opportunity were directly and negatively correlated with intention to leave.

While studying several of the same quality of work life variables, Johnsrud and Heck (1994) took a different methodological approach to identifying issues faculty perceived to be barriers to their success. Specifically, Johnsrud and Heck sought to determine what factors could be attributed to faculty who leave as opposed to those who stay at their institution. They conducted a case study of one public urban institution in the West. A 90-item survey categorized into four dimensions, organizational issues, professional issues that are interpersonal in nature, professional issues that are individual in nature, and personal issues, was distributed to all tenure track faculty hired between 1982 and 1988. Thus, the sample included faculty who were working towards tenure and had earned tenure and stayed as well as those who did not earn tenure and left the university. Employing discriminant function analysis to analyze their data the researchers were able to correctly categorize 78% of those who left. For faculty who left the university, quality of life, chair and department relations, and tenure pressure were identified as barriers to their success.

In addition to quality of work life, several studies have examined work experience variables including salary, rank, research activity, and discipline with regard to intention to leave (Ehrnberg, Kasper, & Rees; 1990; Matier, 1990; Smart, 1990 Weiler, 1985; Zhou & Volkwein, 2004). For instance, Ehrenberg, Kasper, and Rees (1991) conducted a longitudinal analysis of American Association of University Professors (AAUP) data to determine the extent to which faculty turnover was related to the average level of faculty salaries or compensation. To do so, they analyzed trends in the data over 10 years. They found that faculty at lower academic ranks and lower salaries were more likely than their higher rank higher salaried counterparts to leave involuntarily, although their findings suggested that voluntary leaves were more prevalent at higher ranks among higher salaried tenured faculty.

Another line of inquiry has examined how academic factors such as productivity and research interests affect faculty turnover (Blackburn & Havighurst, 1979; Blackburn & Lawrence, 1995; Rosser, 2004; Smart, 1990). Collectively, these studies suggest that faculty members with strong research interests and high levels of engagement in scholarly activities are more likely to remain in their current position as compared to their less interested, less engaged colleagues (Blackburn & Havighurst, 1979; Smart, 1990). For instance, Blackburn and Havighurst (1979) examined career patterns for male social science academics. They studied a group of 74 male social scientists, many of whom were pioneers in their fields, all of whom had remained in their academic careers for at least 60 years. Based on background information they collected from participants, Blackburn and Havighurst grouped these 74 participants into categories depending on the number of research articles produced during their careers. Categories ranged from "inactive" to "very active." The researchers then asked participants to develop career life histories by chronologically identifying the ten major events of their career and to give descriptions of each event. Using content analysis to analyze the career histories, Blackburn and Havighurst were able to identify a list of defining moments and events in the careers these academics. By comparing significant events in a participant's career history, including their decisions to leave a particular position, to their level of research activity, Blackburn and Havighurst found that participants who were more active in their research were more likely to remain at their institution than those who were not as engaged.

Perhaps not unrelated to research activity, Xu (2008a) examined disciplinary differences in intentions to leave. Though structural factors including rank, salary, and research activity had already been examined, Xu suggested that the importance of such factors might differ by discipline. Thus, she analyzed data from the National Study of Postsecondary Faculty (NSOPF:99). The NSOPF sample includes 960 degree granting institutions and more than 27,000 part and full time faculty. Drawing from previous literature on intention to leave, Xu entered data into five regression blocks: demographic, human capital, measures of workload and productivity, perceptions of work environment, and satisfaction. Based on the work of Biglan (1973), Xu ran nine different regression models, one for each of the nine categories of academic disciplines proposed by Biglan. The variance explained in her models ranged from 20% for the *Soft/Pure/Nonlife* group to 35% for the *Hard/Pure/Nonlife* group. She concluded that based on the substantial range of variance explained for various disciplinary groups that academic discipline should not be neglected in studies of faculty intention to leave.

External Factors Related to Faculty Departure Intentions

In addition to internal institutional factors, studies have examined external factors and their relationship to faculty intention to leave (Ambrose, Huston, & Norman, 2005; Matier, 1990; Weiler, 1985; Zhou & Volkwein, 2004). For instance, Matier sought to understand what factors influenced departure decisions of faculty. He suggested that while some factors may push faculty out, others may pull a faculty member from their current position. For example, while a faculty member might be pushed out because they are not satisfied, a competitive job offer from a national lab might pull a faculty member from their current position Thus, Matier suggested that the study of faculty departure "need[s] to be flexible enough to account for this expanded notion of the push-pull metaphor" (p. 41). Drawing on previous studies, including Flowers and Hughes (1973), Hertzberg et al. (1959), and March and Simon (1958), Matier surveyed 221 faculty members from two different institutions who were identified to have firm offers to leave. Questions were designed to elicit information on the faculty member's offering institution as well as their current institution. For each item they were asked to rank the degree of enticement the factors listed had on their decision to stay or leave their current university. Questionnaires were followed up with in person or telephone interviews to gather further information. Finally, departure data were collected six weeks out from the original questionnaire. This provided the opportunity to compare the degree of enticement of a particular push or pull factor to the final decision of the faculty member to stay or leave their current institution. Overall, Matier found that 60% of his respondents ultimately decided to act on their offer and leave their current institution. More specifically, push factors that were significantly influential in the decision making process were, opportunities for research, reputation of associates, and congeniality of associates, reputation of the department and rapport with departmental leadership. On the other hand, pull factors including, income potential, benefit package, and cash salary were also important in departure decisions. Moreover, his research suggested that faculty members who were not satisfied with their current position (i.e., felt internal push to leave), were more apt to consider options from outside. In other words, pull factors only seemed to be important in turnover intentions when faculty also felt pushed from the inside.

Weiler (1985) also surveyed faculty who had received offers to leave their current institution to identify factors that would influence them to stay or to leave. Seventy-one faculty at the University of Minnesota were surveyed on items including measures of salary (e.g., department, rank, years of experience) and the quit decision (e.g., department, years at the institution, and if the faculty member received his or her highest degree from a school in the geographic region near the institution). Using multiple regression, Weiler's results revealed two important findings First, potential for salary increase was a significant factor in decisions to stay or leave their current institution. Second, well over half of his sample cited personal reasons, including family considerations, as an important factor in decisions to stay or leave.

Adding to these findings, Ambrose, Huston, & Norman (2005) interviewed 123 matched faculty (half current and half former) to identify factors of satisfaction and intention to leave. They concluded that positive and supportive relationships with colleagues were the strongest predictors of satisfaction and intention to leave, relationships outside of the workplace also played an important role in affecting departure intentions. That is, faculty who were married and had family responsibilities reported that their family relationships were heavily influential in their decisions to stay or leave an institution. Findings from Daly and Dee's (2006) study of urban faculty corroborated these findings as a majority of faculty respondents in their study with family within 50 miles of the institution at which they were employed were more likely to stay than those with no family within 50 miles.

Models of Faculty Departure Intentions

The most significant contributions to the literature on faculty departure intentions have been made by scholars who have developed and tested models of faculty departure intentions to explain the complex relationships between variables. Four key models, Johnsrud and Rosser (2002); Rosser (2004); Smart (1990); Zhou and Volkwein (2004), are examined below.

Recognizing the complex relationship between the numerous variables related to faculty intention to leave, Johnsrud and Rosser (2002) developed and tested a model of faculty work-life, morale, and intention to leave. Their sample included 1,511 faculty who were employed at a 10-campus system of public higher education in a western state. Participants were asked to indicate their level of agreement on measures of their work-lives, professional priorities and rewards, administrative relations and support, and quality of benefits and services. Using structural equation modeling (SEM) to test their multilevel model, results indicated that faculty perceptions of work-life demonstrated a direct effect on faculty moral, which in turn had a direct effect on intention to leave, thus establishing support for their hypothesis that morale mediated the relationship between perceptions of work-life and intentions to leave.

Adding to the work of Johnsrud and Rosser (2002), Rosser (2004) replicated their study testing satisfaction in place of morale and expanded her site and population to a national study of faculty. Specifically, Rosser sought to examine the relationship between faculty work-life, satisfaction, and intentions to leave to determine if perceptions of quality of work-life influenced intentions to leave. Using SEM on a sample of 12,755 faculty obtained from the National Study of Postsecondary Faculty, Rosser found several important findings. First, her results indicated that perceptions of work-life had a direct and powerful effect on satisfaction, which also had a direct effect on intentions to leave. That is, those who reported positive perceptions of work-life also had reported high levels of satisfaction and were in turn less likely to report intentions to leave. Moreover, she found that female faculty were less satisfied with facets of their job including their advising workloads, the quality of their benefits, job security, and salary levels, than their male counterparts.

A third model of faculty intention to leave was developed and tested by Smart (1990). Smart developed separate models for tenured and non-tenured faculty so that he was able to identify factors that contributed to faculty departure intentions for tenured as compared to non-tenured faculty. Smart’s models included four sets of variables: (a) individual and institutional characteristics, (b) contextual, work environment measures, (c) dimensions of faculty job satisfaction, and (d) intention to leave current institution. Smart hypothesized each set would affect each other in an ordered sequence. Using structural equation modeling techniques on a sample of 190 public and private institutions obtained from the 1984 Carnegie Foundation for the Advancement of Teaching national survey of faculty, Smart’s found that the model explained 13% of the variance in turnover intention for tenured faculty and 14% of the variance in turnover for non-tenured faculty, and confirmed his hypothesis that each set of factors affected each other in an ordered sequence. Smart’s study also contributed several other important findings. First, his results suggested that satisfaction with salary was significant only for non-tenured faculty. Second, he found that tenured faculty who spent more time on research activities and who were more productive were also more likely to report intentions to leave. On the other hand, these variables were not related to intention to leave for non-tenured faculty.

Theoretical Framework

Building on several previous studies and models of faculty departure intentions, Zhou and Volkwein (2004) have developed the most comprehensive model of faculty departure intentions to date. Zhou and Volkwein (2004) sought to determine factors predicting intentions to leave for tenured vs. non-tenured faculty. More specifically, they asked if characteristics of those who intended to leave differed for faculty in tenured and non-tenured positions. To ascertain the answers to this question, Zhou and Volkwein proposed a model of faculty departure intentions which built upon and integrated elements of previous studies and models of faculty departure intentions (Smart, 1990; Matier, 1990). Using data from a nationally representative sample of faculty obtained from the National Center for Educational Statistics' National Study of Postsecondary Faculty (NSOPF:99), Zhou and Volkwein analyzed data from 960 institutions and 28,704 faculty members on information including background, responsibilities, benefits, attitudes, and future plans. Results of their structural equation modeling (SEM) analysis revealed several important findings. First, for tenured and non-tenured faculty, seniority was the strongest predictor of intention to leave. That is faculty members who had been at an institution for the most number of years were also most likely to intend to leave. Additionally, two work factors, academic rank and teaching productivity, were found to be related to departure intentions for non-tenured faculty. For non-tenured faculty, those who were higher in rank and those with lower teaching productivity were also more likely to leave. Second, three measures of job satisfaction: job security, resources, and compensation, were significantly related to departure intentions for tenured faculty. However, only satisfaction with job security significantly impacted intention to leave for non-tenured faculty. Finally, for tenured faculty, unionization was negatively associated with departure intentions and heavy work commitments were positively related to departure intentions.

Faculty Departure Intentions and Women

To conclude this section of the review and transition into section two (women in STEM) this section examines studies that emphasize the importance of studying women as a particular subgroup of faculty. In general, studies on female faculty build on the understanding that women are underrepresented in the academy and thus warrant attention. The justification for this argument is drawn primarily from statistics which show that while the numbers of male and female Ph.D. graduates across disciplines is near equal, a gender gap exists among tenure-track faculty. While some claim gender equality within the academy is not a reasonable or feasible goal, others point out evidence to the contrary produced by scholars who have designed models to predict the gender makeup of the academy over the next few decades. For instance, Hargens and Long (2002) sought to show how demographic inertia influences the gender composition of the academy. Demographic inertia, according to Hargens and Long, is a phenomenon where slow change in demographic factors (e.g., retirement patterns in current faculty, faculty attrition, and gender composition among Ph.D. earners) contributes to conservation of the status quo. Using data on a national sample of tenure-track sociology faculty obtained from the Survey of Earned Doctorates, Hargens and Long conducted a series of regression analyses to predict gender composition in academic departments of sociology. By their projections, given the current patterns and demographic patterns, Hargens and Long predict that the sociology departments they studied will achieve gender equity in 35 years. Their findings lent empirical support to those who contend that changing the gender composition of the academy can be as simple as increasing the number and flow of women in the educational pipeline. Most will agree, however, that changing the gender composition in academic departments sooner than 35 years is desirable. This notation withstanding, Hargen's and Long's innovative methodological approach shows that change could be possible. Furthermore, their study inspired scholars who expanded upon their findings and sought to identify feasible solutions for increasing the number of women in the academy.

Marschke, Laursen, Nielsen, and Rankin (2007) tested Hargens and Long's projections across disciplines. Using data from one "Mountain" university, Marschke and her colleagues collected data from tenure-line faculty in all disciplines over a 10 year span. Using this data, they designed five differential equation models, each corresponding to a particular policy aimed at recruiting and retaining female faculty. They found that if conditions at Mountain University continued as they were, women would never achieve gender parity at the institution. However, by holding the rate at which women and men exit the university constant, women would eventually occupy 43% of tenure-line positions. In other words, simply addressing retention issues would eventually result in gender parity within the Ph.D. pool. Their findings point to the importance of policies aimed at increasing faculty retention.

In their study of the gender composition in academic departments and faculty turnover, Tolbert, Simons, Andrews, and Rhee (1995) collected data on 50 academic sociology departments over a 10 year span. They found that for departments with very few women, increasing the proportion of women contributed to higher levels of female faculty turnover. However, when departments reached a threshold of 35-40% women, their turnover declined. Tolbert and her colleagues suggested that turnover in departments where women were few could be attributed to intergroup conflict, whereas in departments where women were plentiful, such conflict ceased to exist.

In general, justification for studying women in STEM fields centers around the argument that while women in the academy face a number of challenges which impede their success, this is particularly true for women in science based disciplines. Thus the next section examines the research on how challenges that women face in STEM fields influence their decisions to stay or leave STEM disciplines.

Women in STEM

An overwhelming amount of anecdotal and empirical evidence supports the notion that women face a number of challenges in STEM disciplines (e.g., Monosson, 2008; Rosser, 2004; Settles, Cortina, Malley, & Stewart, 2006; Sonnert & Holton, 1995; Sallee & Blakewood, in review; Strayhorn, DeVita, & Blakewood, 2012 in press). These persistent challenges lead to negative job outcomes for women in the sciences including lower levels of productivity, satisfaction, and attrition, the focus of this study. In this section, the research and literature on women in STEM fields is examined to identify the challenges women face as students, professionals, and faculty.

Women as STEM Students

Throughout their educational trajectory, women face a number of challenges that hinder them from entering into and persisting in STEM disciplines. At the student level the extant literature tends to focus on four general areas of challenge: (a) pre-college preparation, (b) choice of major in STEM fields, (c) internal factors contributing to women's success in STEM, and (d) external factors that influence women's success in STEM. These areas are reviewed in more detail here.

Pre-college preparation.

It is well established that the challenges to recruiting and retaining women in STEM fields begin long before college (Benbow & Stanley, 1983; Burkham, Lee, & Smerdon, 1997; Catsambis, 1994; Davenport et al., 1998; Leslie, McClure, & Oaxaca, 1998; Post-Kammer & Smith, 1986; Smith & Erb, 1986; Tyson, Lee, Borman & Hanson, 2007). To better understand why women are less likely to pursue STEM related majors and careers at the collegiate level, scholars have investigated gender differences during their pre-college years. For example, in their study of almost 40,000 seventh graders from the Middle Atlantic region of the United States, Benbow and Stanley (1983) used descriptive statistics to analyze gender differences on the results of the College Board Scholastic Aptitude Test which was part of the Johns Hopkins regional talent search over a three year span from 1980 to 1982. Results from their analysis revealed that by age 13, boys were significantly outperforming girls on measures of mathematical reasoning ability. This was especially true on the higher end of the ability scale; among students who scored higher than a 700 (90^{th} percentile or above), boys outnumbered girls 13 to 1.

This pattern seems to continue and increase as students move along in their education. Two studies that employed the same methodology to study the science experiences of 8th graders (Lee & Burkam, 1992), and the same group again as high school 10^{th} graders (Burkham, Lee, & Smerdon, 1997), provided evidence that as students moved through the educational pipeline, the advantage males demonstrated in science increased. Each of these studies drew their sample of about 25,000 students in 1,035 American schools from the National Education Longitudinal Study of 1988 (NELS:88) to identify gender differences in science experiences in the classroom and the laboratory. Using a combination of descriptive and multivariate regression analysis, Lee

& Burkham (1992) found that in 8th grade males reported slightly more lab experiences and interaction with science teachers, and slightly better attitudes towards science than female students who tested at the same ability level. By 10th grade, this same group of students showed greater gender differences than in 8th grade. That is, males were increasingly more likely to report more lab experiences and interaction with science teachers, and better attitudes towards science, whereas their female peers reported experiences and attitudes towards science declined. These differences were most pronounced in the physical sciences (Burkham, Lee, & Smerdon, 1997).

Similarly, research has also looked at gender differences in math confidence or efficacy, interest, and learning opportunities. In their study, Post-Kammer and Smith, 1986, sought to examine gender differences in math and science self-efficacy, interests, and career consideration among disadvantaged high school students enrolled a precollege program. A group of 357 high school students and recent high school graduates who met a predetermined set of criteria completed a three page questionnaire based on the work of Hackett and Betz (1981) that included measures of (a) self-efficacy, (b) confidence, (c) interest, and (d) career consideration. Chi-square statistics and regression analyses indicated that the proportion of females reporting positive self-efficacy for math related occupations was highest for nurse (73%) and lowest for engineer (37%). For males, on the other hand, it was highest for computer programmer (89%) and lowest for physician (57%). Despite these significant sex differences in self-efficacy for math related careers, no sex differences were found for non-math related careers. Moreover, in their study, math interest and consideration were significant predictors of success in math courses for males, but not for females. Catsambis (1994) looked at gender and race differences in related variables including learning opportunities, achievement, and choice of math courses.

Catsambis used data from the NELS:88 to analyze data from a sample of 24,500 students from 1,052 high schools. Employing logistic and OLS regression, Catsambis did not find evidence that female and male test scores differed. However, females showed less interest in math and less confidence in their mathematic reasoning and problem solving abilities. Moreover, she reported that differences in confidence, interest, and self-efficacy may extend beyond gender to race as well. Her findings suggested that gender differences were largest among Latino students and smallest among African American students. Furthermore, white females and minority students of both sexes reported barriers to math achievement including negative attitudes towards math and unlikeliness of pursuing a math related career.

Smith and Erb (1986) argued that it is necessary to change the attitude of females towards math and science during the adolescent years so that they are more likely to become interested in and pursue STEM related majors and careers. They hypothesized that both female and male students might benefit from mentoring during this critical adolescent period, and designed a study to test this hypothesis. They set up a treatment group of students in middle and junior high school from eight locations across the United States who were exposed to women scientist career role models for two months as part of their science instruction. Students in the control group did not have exposure to the role models. Role model visits were based on an NSF funded instructional program (Smith, Molitor, Nelson, & Matthews, 1984). Student evaluations during the pre-test and post-test used the Science and Scientists Scale and the Women in Science Scale (Erb & Smith, 1984). Following exposure to the role models, both female and male students in the treatment group showed significantly more positive attitudes towards science than those in the control group.

Another line of related research examined STEM preparation in high school. Tyson, Lee, Borman, & Hanson (2007) examined the effect of taking high school STEM courses on future STEM degree attainment in college. Using data obtained from the Florida Longitudinal Education and Employment survey, which collects information on 94,078 students from 350 public schools in the state of Florida, they found that students who took high school courses at the highest levels of science (e.g., Physics I, Chemistry II, or Physics II) were the most likely to obtain a degree in STEM. Moreover, they found that although women tended to take high level math and science courses in high school, they were less likely than men to take courses at the highest levels. Even the women who took the highest level courses were less likely than men to choose to major in a STEM field. Black and Hispanic students were less likely than white students to take the highest level high school math and sciences courses. However, among those who did take the highest level courses, they were just as likely as White students to major in STEM. Davenport et al., 1998, also investigated gender and race differences in the type of math and science courses taken in high school. Data for their study, over 23,000 student transcripts from U.S. high schools, were obtained from the High School Transcript Study for the National Center for Education Statistics. Davenport et al.'s (1998) findings were similar to Tyson and his colleagues. That is, white men were the most likely to take the highest level math and science courses, and minority women were the least likely to complete high level high school math and science courses. In sum, these studies suggest that gender differences in social cognitive variables including attitudes, self-efficacy, and interest in math and science, begin to develop prior to college and influence subsequent decisions about choosing STEM courses and occupational fields . Another line of research explores how these social cognitive variables may affect choices women make in pursuing STEM related majors and careers.

Social cognitive variables and pursuing STEM in college.

Even for women who are well prepared to succeed in STEM in college, many choose to pursue other fields. Thus, the transition from high school to college is regarded as one of the major leaks in the educational pipeline. In order for women to pursue STEM related careers, first, they must decide to choose a STEM major. Several studies have examined factors that contribute to choice of STEM major in college. For example, in one study, Astin and Astin (1992) identified background and college experiences that affected students' interest in studying science and pursuing college related careers. Data were obtained from the Cooperative Institutional Research Program (CIRP) survey, which includes 192,453 students from 372 institutions. The survey collected information on students' demographic characteristics, high school activities and achievements, as well as a number of subjective variables including career aspirations, values, and expectations of college. Multiple regression analysis produced several important findings. First, the strongest and most consistent predictors of interest in science majors and careers was students' entering level of mathematical ability. Additionally, Astin and Astin (1992) reported that among ethnic groups, Asian-American men and women were most likely to pursue STEM majors, particularly engineering. Moreover, Asian-Americans were the least likely group to leave a STEM major, while their White female peers showed the greatest proportional loss from STEM majors in college.

Another group of scholars, Leslie, McClure, and Oaxaca (1998), sought to identify the most important factors contributing to female choice of a STEM major. They started with an extensive synthesis of the literature on this topic and identified factors including self-concept, self-efficacy, the influence of peers, and commitment, as important factors associated with a choice of major in a STEM field. Using the variables identified, they estimated binomial logit, multinomial logit, and ordered logit models with data from two national data bases: (a) the Cooperative Institutional Research Program (CIRP) files, and (b) the National Longitudinal Survey of Youth (NLSY) ,in an attempt to predict choice of major for 9,628 incoming college Freshmen. Leslie and colleagues were able to accurately predict 46% of first choices in college major. As hypothesized, women started with lower math self-efficacy, had fewer peers who planned to enter STEM fields, and exhibited lower commitment to math and science in high school. Subsequently, females were also less likely than males to select a STEM major when entering college.

Hackett and Betz (1989) also studied how factors, namely self-efficacy, math performance, and attitudes towards math, were related to the choice of a mathematics-related major in college. Participants were 262 undergraduate students enrolled in a psychology course at one large Midwestern university. Students completed a survey during class which contained sub-scales from several established questionnaires including: (a) the Background and Career-Plans Questionnaire, (b) the Mathematics Self-Efficacy Scale (Betz & Hackett, 1983), (c) Dowling's (1978) Mathematics Confidence Scale, and (d) the Fennema-Sherman Mathematics Attitude Scale. To analyze the data, Hackett and Betz first conducted a microanalysis where they computed indexed scores for each student to allow them to compare student scores and interpret data appropriately. Analysis revealed that as compared to students with low scores on mathematics self-efficacy, math performance, and achievement, high scoring students reported lower levels of math anxiety, and higher levels of confidence and motivation, and were more likely to view math as useful. Moreover, results of the multiple regression the conducted indicated that among students who reported high levels of math self-efficacy and more years of mathematics preparation, men were more likely than women to choose a math-related major.

Finally, math self-efficacy was the strongest predictor of choice of math major in college for women and men.

Similarly, Ware, Steckler, and Leserman (1985), also identified factors that contribute to women's choice of a science major in college. They studied a group of 300 incoming freshmen who indicated an interest in pursuing a science based major in college. They selected a purposeful matched sample so that half of participants (150) were women, and half (150) were men. These groups were matched in that both the male and female group had similar standardized test scores with a mean score of 660 on the math and 620 on the verbal sections of the SAT. Additionally, the groups were matched on measures of levels of interest and number and type of mathematics courses taken in high school. With these controls in place, this design allowed researchers to focus on gender differences in college experiences which contribute to the choice of a STEM major. Participants completed a questionnaire on demographic characteristics, personal background, college experiences, choice of a major, and plans for a career. Follow up interviews were also conducted on a yearly basis with a subsample of 20 men and 20 women to gain further insight into the experiences of college for these students. Initial descriptive analysis revealed that although nearly all students in the sample indicated a strong possibility of pursuing a science based major in the summer prior to the students arrival at college and in a follow up in November, at the time of major declaration, significantly fewer women (50%) than men (69%) actually declared a STEM major. In an attempt to explain this sex difference, Ware and colleagues created a path analytic model that included demographic variables and measures of preparation, scientific aptitude, and expectations. Results suggested that factors that shaped choice of major differed for women and men in college. For women, the most significant factors influencing choice of major included family background, mathematic ability, and a need to feel powerful. That is, women reported choosing a STEM major because someone in their family was also in STEM, they performed well in math, or they felt STEM majors afforded them the most prestige or power. Men, on the other hand, were most influenced to opt into a STEM major by their commitment to a major before college and their success in math and science courses during their first year of college.

Collectively, these studies identify a number of social cognitive factors that influence women's choice of a STEM major in college. Other scholars have examined how many of these same factors, including self-efficacy, interest, and expectations, also affect other outcomes, like career aspirations. Lent, Lopez, and Bieschke (1991) were interested in examining the relationship between self-efficacy, outcome expectations, interest in mathematics-related courses, and students' choice of a science-based career. One hundred and thirty-eight students who were enrolled in an introductory psychology course at a large Midwestern university completed a questionnaire which included measures of demographic characteristics, mathematic self-efficacy, outcome expectations, mathematics related course interests, career choice, and perceived sources of math self-efficacy. Multiple regression analysis revealed that men reported higher levels of mathematics self-efficacy than women. Furthermore, the relationship between mathematics self-efficacy and choice of a science-based career was mediated by efficacy building experiences (e.g., past performance). Another group of scholars, Nauta, Epperson, and Kahn (1998), also explored the impact of ability, self-efficacy, role model influence, and role conflict on career aspirations for female undergraduates. Specifically, they looked at two groups of females in science, mathematics, and engineering majors to understand differences between women in (a) mathematics, physical science, or engineering majors, and (b) biological science majors. In total, their sample consisted of 564 women at one large Midwestern university. After collecting questionnaires which were mailed to participants, Nauta and colleagues tested a model they built based on previous research using structural equation modeling. Their study supported existing findings that self-efficacy mediates the relationship between ability and career aspirations. This was especially true for women in science, mathematics and engineering majors as compared to those in biological life science majors.

Similarly, Hackett, Betz, Casas, and Rocha-Singh (1992) studied the relationship between self-efficacy, vocational interests, expectations, ability, perceived stress, support and coping, to academic achievement in math and science. Studying 197 students who were enrolled in engineering or science majors at a midsized university on the West coast, Hackett and colleagues designed a questionnaire that elicited information on students' demographic characteristics, occupational aspirations, self-efficacy, interests, expectations, stress, strain, coping strategies, and support. Using a combination of analysis of variance and regression techniques, they found self-efficacy to be the strongest predictor of academic achievement. Moreover, outcome expectations, vocational interests, and low stress levels were the strongest predictors of math and science self-efficacy.

Pajares and Miller (1994) also tested the meditational role of self-efficacy in math problem solving ability for 350 undergraduates at a large public university in the South. They developed an instrument using the problems scale of the Mathematics Confidence Scale (Dowling, 1978), as well as measures of demographic characteristics, background preparation, math self-efficacy, math anxiety, and perceived usefulness. Using this data they developed and tested a path analytic model. Results indicated that, as hypothesized, men reported higher levels of self-efficacy than women, and women, higher levels of math anxiety than men. Men also performed better on average than women. Math self-efficacy, math self-concept, and high school level were all significant predictors of math performance. Self-efficacy also mediated the relationship between gender and prior experience on self-concept as well as perceived usefulness of mathematics and problem solving.

In her study of 130 students enrolled in an introductory computer science course at a large Midwestern university, Wilson (2002) identified factors that promote success in computer science. Data were collected by means of a survey designed by the researcher. It included the Computer Programming Self-Efficacy Scale (Ramalingam & Widenbeck, 1998), as well as measures of demographic characteristics, mathematic background and preparation, previous programming experiences, previous computer experiences, encouragement of others to pursue computer science, comfort level with computers, work style preference, and attribution of success or failure on the midterm exam. The overall regression model was significant and accounted for 44% of the variance in the midterm exam grade. Findings revealed that comfort level was the best predictor of success in the course, with math background being the second most powerful predictor of success in computer science for both sexes. Men however, were more likely to report higher comfort levels and stronger math backgrounds than women.

Brainard and Carlin (1997) extended the findings of previous scholars in examining how social cognitive variables affected retention of females in science and engineering. They designed six instruments to gather information regarding students' demographic characteristics, background, academic interests, support, confidence level, and perceptions of campus climate, and quality of teaching, from 100 students over a five year time period. Initial data collection took the form of structured interviews during the fall and spring semesters of the students' first year. Follow-up questionnaires were sent via e-mail during the students' sophomore, junior, and senior year of college. Logistic regression analysis in combination with support from qualitative interview findings suggested that during the first year of college, interest in math and science courses, the positive influence of role models in the field, and the ability to work independently were the most important predictors of persistence. In year two, career opportunities, positive or negative experiences in math and science classes, commitment to a math or science major, and positive interaction with advisors were significantly related to persistence. At the end of the junior year, the influence of a mentor, positive experiences in math and science courses, and experiences in student societies and conferences and events were the most predictive of persistence in math and science. Finally, in students' senior year involvement in a program, serving as a mentor to incoming women interested in math and science, as well as the influence of an advisor or mentor, and experience in math and science courses, significantly predicted retention in a math or science major. Furthermore, Brainard and Carlin also inquired about perceived barriers to success. The most commonly cited barriers to success were lack of self-confidence, worry about not being accepted to major in the area of study, and feelings of isolation. Of note, 30% of first and second year women reported feeling no barriers to persisting in science or engineering. Interestingly, by year four, almost all students who remained in a math or science degree program, including those who previously reported no barriers, reported at least a few barriers to success in persisting.

While the studies reviewed so far took a quantitative approach to examining social cognitive variables and their effect on women's decisions to pursue STEM in college, others have looked at these issues through a qualitative lens. For example, Erwin and Maurutto (1998) sought to understand how female undergraduate science students construct their aspirations, educational experiences, achievements, and opportunities though their educational journey. Based on 91 in-depth longitudinal interviews at one large, urban Canadian university, Erwin and

Maurutto focused on identifying participant experiences and exploring how they made sense of those experiences in the context of their social milieu. Interview questions centered around four themes: (a) participants' social, educational and family background, (b) future career and personal aspirations, (c) expectations and experiences in the university, (d) attitudes towards a range of political and social issues. Erwin and Maurutto also interviewed students who left the major and for these participants, questions concerning the reasons why they left were included in the interview protocol. From their interviews, the researchers had several findings. First, social-psychological and chilly climate issues to be the most prevalent among their participants. Additionally, within their sample, the areas with the fewest women (i.e., computer science, mathematics, and physics) also had the highest attrition rate, whereas the area with the highest concentration of women (i.e., biological sciences) had over 90% persistence from the first to second year. Most all participants, regardless of achievement during their first year, reported that they were less optimistic about their ability to be successful in the field, and had more anxiety by their second year of college. For the women who left, almost all considered leaving to be a personal failure, and attributed their leaving to a lack of ability, drive, or focus.

Similarly, Etzkowitz, Kemelgor, and Uzzi (2000) synthesized findings from five studies, both qualitative and quantitative, to write their book, *Athena Unbound: The Advancement of Women in Science and Technology*. Taken together, their findings are based on hundreds of interviews that are supported with quantitative data. Using the research studies as support, the book traces the trajectory of women from birth through their scientific career. Through detailed personal accounts from women scientists, the authors illustrate how critical "social capital" (e.g., strong network of and relationship with colleagues, access to research and or grant opportunities) is to the career success and research discoveries of scientists. Furthermore, Etzkowitz and colleagues argue that the lack of social capital leaves women disadvantaged in the sciences.

Adding to these findings, Margolis and Fisher (2002) examined how the experiences and culture of computer science affect women. Drawing on nearly four years of interviews (n = 97), supported by classroom observations and demographic survey data with male and female computer science students at Carnegie Mellon University, the authors reported several important findings. First, while almost all students, male and female, entered with high levels of optimism for their success and interest in computer science, by the end of sophomore year, women were more likely than men to report lower levels of optimism and interest. Women participants in their study often talked of struggling with confidence and to maintain interest in computer, whereas men rarely mentioned these types of issues. Moreover, while both men and women participants spoke about being stereo-typed as only being interested in computers or being computer geeks, women were much more likely than men to be bothered by such labels and felt that they were more stigmatizing for women than men.

Clearly, women struggle with a number of barriers that impact their decisions to pursue STEM related majors and careers. Still, even for women who continue in the STEM pipeline, challenges persist beyond the student level and into the professional and faculty levels.

Challenges for Women as STEM Professionals and Faculty

A line of research has examined challenges for women as STEM professionals and faculty. Similar to research on faculty departure intentions, studies on women in STEM argue that because science-related disciplines are traditionally male-dominated, the general challenges females face in the academy are exacerbated by their low-representation. For instance, Kulis, Sicotte, and Collins (2002) examined three different possible explanations for women's underrepresentation in academic science, (a) labor market factors, (b) institutional explanations, and (c) gender role expectations. The sample consisted of 13,231 faculty from 1,071 universities obtained from the 1989 Survey of Doctoral Recipients (SDR). Data were analyzed using hieratical logistic regression to predict the odds that faculty were female. From their analysis, the authors concluded that labor market factors, institutional explanations, nor gender role expectations alone could accurately account for the gender composition patterns in science disciplines.

Similarly, Sonnert and Holton (1996) also explored how various factors were related to gender disparity in science disciplines. As part of a larger project, Sonnert and Holton collected data on close to 700 male and female recipients of prestigious science post-doctoral fellowships. Analyzing data obtained through 699 responses to structured questionnaires and 200 interviews, they found that 72.8% of women participants reported experienced discrimination at some point in their academic careers. Moreover, 51.5% of the women participants reported lacking confidence in their scientific abilities. Lack of confidence may lead to other undesirable outcomes that may impede progress for women in STEM. For example, in their study exploring gender patterns in research and licensing activities of science and engineering faculty, Thursby and Thursby (2005) studied the personal profiles of 4,621 faculty at 11 major research universities over a 17 year period. Data were analyzed using logit regression. Though the regression was not significant, analysis revealed that women were less likely than men to disclose inventions. The authors theorized that this difference in disclosure patterns could be attributed to differences in confidence levels as well as a lack of trust in colleagues or feelings of isolation within their department.

Other studies have empirically examined such psychosocial factors which may contribute to female faculty success in STEM fields. For example, Callister (2006) studied how gender and perceptions of departmental climate affect work outcomes for women, including job satisfaction and intention to quit. Callister collected data by surveying 416 science and engineering faculty at one Western university. Survey items included demographic characteristics, as well as measures of affective department climate, instrumental department climate, cognitive department climate, job satisfaction, and quitting intentions. Structural Equation Modeling revealed a strong direct effect of department climate on both job satisfaction and intention to quit for female science and engineering faculty. A second important finding was that while female faculty reported lower job satisfaction and higher intentions to quit than men, this relationship was mediated by department climate. In other words, levels of satisfaction were directly related to perceptions of the department climate, and perceptions of department climate in turn were directly related to intentions to quit. In a similar study, Settles, Cortina, Malley, and Stewart (2006) studied the effect of personal negative experiences and perceptions of workplace climate on workplace outcomes, including job satisfaction, felt influence, and productivity. At one large Midwestern university, the authors sent a 10-page survey to all tenure line female science and engineering faculty. Using a combination of MANOVA and hierarchical regression analyses, Settles and colleagues found that negative gender-related experiences (i.e., gender discrimination or harassment) were the strongest predictors of low job satisfaction. Gender discrimination also contributed to low levels of felt influence for female science and engineering faculty. Furthermore, participants who held negative feelings about the climate in regard to sexism also reported feeling less influence and lower levels of job satisfaction.

In her study of gender differences in STEM faculty's intention to leave, Xu (2008b) analyzed data provided by the National Study of Postsecondary Faculty:1999 on approximately 27,000 faculty employed at 960 institutions. From a combination of MANOVA and regression statistics, Xu was able to explain 24% of the variance in intention to leave for men and 26% for women. Specifically, she found that women were more likely than men to change positions within the academy. Moreover, she identified several factors that were highly correlated with turnover intentions for women, including dissatisfaction with research support, career opportunities, and feeling a lack of freedom to express ideas.

While the studies reviewed thus far have examined challenges women face in STEM fields quantitatively, other scholars have explored similar issues qualitatively. For example, Fox and Colatrella (2006) interviewed 20 tenure-track women in computer science, engineering, sciences, and social sciences at one major technical research university as part of the National Science Foundation's ADVANCE project, to understand the experiences, participation levels, performance, and advancement of women faculty in these STEM disciplines. From interviews, participants identified the best aspects of a career in academia to be autonomy/freedom in research and teaching, as well as interaction with students. Moreover, participants characterized success as an academic as being recognized and respected both in the field as a researcher, and with students in the classroom. For the women in their sample, 89% were at least moderately satisfied with the research and teaching aspects of their career. When asked about the role of personal factors and their satisfaction, an overwhelming majority (95%) agreed that these factors affected advancement, yet 90% of these same women believed that discussing personal factors could be offensive or damaging to their careers.

Indeed, other studies have also suggested that women in STEM have difficulties integrating their personal lives with their work lives. In their study, Grant, Kennelly, and Ward (2000) sought to examine the intersections of marriage, parenthood, and productivity for male and female academic scientists. Earlier work by Cole and Zuckerman (1987) had used simple descriptive statistics to compare how marriage and motherhood affected research productivity. Although results from Cole and Zuckerman's study suggested that women scientists who were married and had children published as much as those who were single and did not have children, these findings were counter-intuitive to anecdotal evidence. Thus, Grant, Kennelly, and Ward (2000) decided to further examine how marriage and parenthood affected productivity in science qualitatively. Their study included in-depth interviews of 602 faculty who taught in American doctoral degree granting institutions. From these interviews, Grant and colleagues learned that participants, women in particular, had difficulty talking about the way they combined work and family lives. For those who did talk about marriage and family, they were careful to focus on work lives first, and home lives second. Participants in general, both women and men, acknowledged and accepted the "greedy" nature of their career; few tried to challenge demands on their work time, and compensated by structuring family demands around work. In a similar study, Rosser (2004) examined barriers to success of female faculty in science and engineering. Rosser sent a series of open ended questions to 389 faculty who had either received funding from a prestigious National Science Foundation program, Professional Opportunities for Women in Research and Education (POWRE) between 1997-2000,or been named a Clare Boothe Luce (CBL) Professorship recipient. These questions were supplemented by data from 50 in-depth interviews. From Rosser's data, several themes emerged. First, by far the most commonly cited barrier to success for these women (88%) was "balancing career and family". Additionally, 63%

of women reported problems due to low representation, including gender stereotypes, harassment, and discrimination, to be significant barriers to their success in science and engineering. Finally, participants identified struggling for resources in a tight economy as a barrier for success. Women, in particular, noted that in these times, often they took on additional responsibilities in teaching and advising, which put further demands on their time, and impeded their research production.

Conclusion

Taken together, this review provides the background on faculty departure intentions and describes issues that point to a number of barriers for women as STEM students, professionals and faculty. To this end, identifying challenges for women in STEM remains an important priority for administrators and policy makers as these issues negatively affect job outcomes such as job satisfaction, productivity, and intention to leave for women in STEM. In an effort to continue to recruit and retain women faculty, and in particular those in STEM, it is important to study how various factors effect turnover intentions for general female faculty as compared to those in STEM disciplines. This study will provide a more nuanced understanding of how these two groups of female faculty (i.e., those in STEM and those in non-STEM fields) are similar as well as different. With this knowledge, educational stakeholders including campus administrators and policy makers, may create more informed practice and policies to aid in recruitment of female faculty members in STEM disciplines.

Chapter III

Methods and Procedures

In this chapter, the purpose of the study is reviewed. Then the research design is explained, followed by the provision of the details and information on the data sources and instrumentation. Finally, the procedure, data collection, and data analysis methods are outlined. The chapter concludes with a summary paragraph.

Purpose of the Study

The purpose of this study is to test the relationships between variables in Zhou and Volkwein's (2004) model of faculty departure intentions and determine if the model "fits" departure intentions for women faculty in STEM and non-STEM fields. Specifically, the study will address the following research questions:

1. What are the relationships between the constructs and variables presented in Zhou and Volkwein's (2004) model of faculty departure intentions and intention to leave for women faculty members in STEM and non-STEM fields?
2. Does the statistical model demonstrate better predictive validity for female faculty in STEM or non-STEM fields?

Research Design

This study employs a quantitative methodological design. More specifically, this study is an example of a replication study which uses secondary data obtained from a large national database provided by the U.S. Department of Education's National Center for Educational Statistics. These data were analyzed using a combination of descriptive and correlational statistics as well as the statistical modeling technique, structural equation modeling (SEM).

More information on the use of these statistical techniques for analysis is provided later in this chapter.

Data Source and Instrumentation

This study utilized data from the National Center for Education Statistics' National Study of Postsecondary Faculty (NSOPF) survey. NSOPF is designed to secure data about university faculty in an effort to "understand who they are; what they do; and whether, how, and why they are changing" (NCES, 2010). There have been four cycles of NSOPF surveys. Though there have been slight differences in the various cycles, each wave includes information on the backgrounds, responsibilities, workloads, salaries, benefits, attitudes, and future plans of part and full time university faculty. Thus, NSOPF continues to be the most comprehensive faculty survey to date (NCES, 2010). To be considered for inclusion in NSOPF all institutions must be located in the United States and meet the following criteria: (a) Title IV participating and degree-granting, (b) public, private, not-for-profit status, and (c) associate's, bachelor's, or advanced degree conferring.

Data collection procedures for NSOPF:99.

Data collection for the NSOPF:99 survey instrument proceeded in three stages. First, approximately 28,600 faculty and instructional staff from 960 postsecondary institutions were sent the initial self-administered survey. In stage two, a subsample of 19,813 were drawn from the original sample and sent a follow-up questionnaire. Finally, a subsample was selected for follow-up telephone interviews.

Of those originally sampled, approximately 18,000 survey responses were received resulting in an 83% response rate for the faculty survey. The institutional survey response rate was 93%.

Both the faculty and institution surveys from NSOPF:99 can be found at the NSOPF homepage under survey forms http://nces.ed.gov/surveys/nsopf/survey_forms.asp.

NSOPF composition.

NSOPF is divided into two sections: a) the institution survey, and b) the faculty survey. Section one, the institution survey, is further organized into five subsections. These include: (a) the number of faculty, (b) faculty hires and departures, (c) tenure status of faculty (d) tenure policies, and (e) retirement and other benefits of faculty. Part two of NSOPF, the faculty survey, is comprised of 11 subsections. These include: (a) socio-demographic characteristics, (b) academic and professional background, (c) field of instruction, (d) employment history, (e) current employment status including rank and tenure, (f) workload, (g) courses taught, (h) publications, (i) job satisfaction and job-related attitudes , (j) career and retirement plans, and (k) benefits and compensation. Items from both the faculty and institution survey were utilized for this study.

Sample Selection

All participants were drawn from NSOPF:99. Though there were several waves of NSOPF available, only the 1999 wave asked questions about intention to leave, the focus of this study. Therefore, NSOPF:99 was deemed the only appropriate wave of the data to utilize. All of the NSOPF:99 data was not used. Rather, several limits were imposed on the original sample of faculty collected by NSOPF to better fit the purpose of this study. First, only women were included, as the purpose of this study is to compare departure intention patterns for women in STEM as compared to those in non-STEM fields. Second, similar to others who have studied female faculty using NSOPF data (see for example Xu, 2008b), the sample was limited to include only tenure line faculty at research and doctoral institutions. Finally, the sample was further defined to include only faculty in the *Hard science* disciplines in the STEM category. The academic disciplines in both STEM and non-STEM fields are operationalized according to an empirical classification proposed by Biglan (1973), where academic disciplines are grouped and classified across three dimensions: (a) *Hard* versus *Soft*, (b) *Pure* versus *Applied*, and (c) *Life* versus *Nonlife*. Based on previous literature which suggests that faculty experiences, and female faculty in particular, differ among fields within STEM disciplines (Kulis, Sicotte, & Collins, 2002; Nelson & Rogers, 2005), the researcher deemed it necessary to include only faculty in the *Hard* disciplines. Similarly, for the non-STEM group, only those faculty members who fell into the *Soft* disciplines (e.g. humanities) according to Biglan's classification were included for comparison. These restrictions resulted in a final sample of 1216 faculty members. Of these 253 were grouped into the STEM discipline category and 963 were grouped into the non-STEM discipline category.

Sampling Design

NSOPF:99 employs a complex stratified sampling procedure. Stratified sampling differs from random sampling in that some subjects have a better chance of being selected for participation than others. This sampling method is appropriate for NSOPF because of the wide variety of faculty at various institutions and groups that are proportionately underrepresented (e.g., women and faculty of color). Thus, the researchers opted to use stratified sampling to ensure that equal numbers of individuals from across demographic and Carnegie class institution level groups were fairly represented. In other words, because of their proportionately low numbers, women faculty were oversampled. For similar reasons, faculty from small private liberal arts institutions were also oversampled in the NSOPF:99 survey (NSOPF:99 Methodology Report). To ensure that use of a stratified sampling procedure does not adversely affect data analysis, faculty responses are weighted to reduce sample bias and to ensure that findings are valid and generalizable. The weights were created using a combination of factors including institution size and faculty non-response rates to account for stratified selection and sampling of faculty and institutions. (For more information on weighting used in NSOPF please refer to the NSOPF:99 methodology report http://nces.ed.gov/surveys/nsopf). The NSOPF:99 database provides a raw weight used to account for over and under sampling, however, its mean is greater than 1. Thus, statistical software commonly used to analyze data (e.g., SPSS and AMOS) overestimates the size of the sample. To correct for this error, a relative weight was created by the researcher by dividing the raw weight by its mean and applying it to the sample. This technique is considered an appropriate way to correct for complex sampling designs like the one used to collect NSOPF data (Thomas & Heck, 2001). Moreover, standard statistical software assumes data will have been randomly sampled. Considering NSOPF employed stratified sampling, it was necessary to further adjust the weight to account for this design effect so that the correct standard errors would be produced. To accomplish this task, first the design effect was calculated by dividing the variance of the complex sample by the variance of the simple random sample. Then, the adjusted relative weight was calculated by taking the inverse of the design effect and multiplying it by the relative weight. Adjusting the relative weight is necessary in order to produce correct standard errors for model testing (Zhou & Volkwein, 2004).

Appropriateness of NSOPF for the Study

This study examines a critical aspect of faculty life, turnover intention for female faculty in STEM versus non-STEM fields. As with many other studies of turnover intention, NSOPF data will be used in this study.

NSOPF data are particularly appropriate for the study for three reasons. First, the nature of the study benefits from the use of a large national database. National databases like NSOPF, provide access to a large national sample, one that would otherwise be difficult to obtain. Hence, provided that appropriate weights are applied to adjust for oversampled populations (Thomas & Heck, 2001), findings from studies using NSOPF, including this one, are generalizable to the larger population. Therefore, analysis of this secondary database is ideal for SEM modeling, which is most appropriately used to estimate or test relationships between a series of variables.

In addition to the benefits of using a national database, NSOPF in particular offers some distinct design features that render it especially appropriate for this study. In order to compare pathways of turnover intent for women in STEM versus non-STEM fields, it is important to be able to create separate models for women in STEM and non-STEM disciplines. To this end, NSOPF data identifies not only faculty members' field of study (e.g., engineering), but also their subfield (e.g., civil, mechanical). This design feature is important for my research because it will allow me to separate women into the appropriate discipline groups. Given that research suggests that experiences may differ for women in the sciences based on their subfields (Kulis, Sicotte, & Collins, 2002; Nelson & Rogers, 2005), this will allow for comparisons based on subfields for STEM faculty. Thus, use of NSOPF data will allow me to operationally define STEM according to Biglan's (1973) framework where academic disciplines are grouped and classified across three dimensions: 1) *Hard* versus *Soft*, 2) *Pure* versus *Applied*, and 3) *Life* versus *Nonlife* (see also Xu, 2008a; Xu, 2008b).

Another feature of the database makes NSOPF particularly appropriate for the study, its two-part construction. In its entirety the quantitative portion of NSOPF consists of an institution and faculty survey. Prior research has identified a number of variables at both the instructional (structural) and faculty (individual) levels that are related to faculty turnover (Matier, 1990; Rosser, 2004; Smart, 1990; Zhou & Volkwein, 2004). To effectively study and model faculty turnover, it is important to include as many relevant variables as possible. Although NSOPF does not include all variables known to affect faculty intent to leave, it is the most comprehensive study of postsecondary faculty to date (NCES, 2010).

Finally, a secondary purpose of the study is to provide further empirical testing for a model of faculty departure intentions posited by Zhou and Volkwein (2004). Given this intent, it is necessary to follow the methodology described by Zhou and Volkwein in their study. Although NSOPF is currently in its fourth cycle (NSOPF:04), unfortunately, this version does not ask questions about intent to leave. Thus, consistent with other scholars who have studied faculty turnover, including Zhou and Volkwein, data from the NSOPF:99 cycle will be analyzed in this study.

Validity and Reliability

Several steps were taken by the researchers who created NSOPF to ensure the reliability and validity of the NSOPF instrument, all of which are outlined in the NSOPF:93 and NSOPF:99 methodology reports http://nces.ed.gov/pubs97/97467 and http://nces.ed.gov/pubs2002/2002154. Though measures of reliability and validity were conducted for the NSOPF:99 instrument, because the instruments are essentially the same, only the NSOPF:93 methodology report includes all statistical results of these tests. In accordance with definitions used in the NCES methodology reports, validity and reliability are defined respectively as the correlation between the measured and true values of a characteristic or attribute and the correlation between repeated measures of the same item (Groves, 1989 cited in NCES, 1993)

Validity.

Several measures of validity were calculated for the NSOPF survey. Initial measures of comparative validity in the field test were evaluated by comparing selected items from the faculty survey to data obtained from the institutional survey. From the comparisons, evaluations of faculty members' self-report were validated. Results indicated that data regarding faculty gender, race/ethnicity and employment status were consistent in over 90 percent of sample cases, and approximately 70 percent consistent for reports of principle discipline or field. Statistical measures of association including chi square and Cramer's V were also calculated as well as two measures of inconsistency, (a) percent inconsistent and (b) index of consistency. Results from these statistical calculations indicate on all accounts that the NSOPF full scale study is a valid instrument.

Reliability.

Reliability for the field test was evaluated using test-retest reliability measures where a subsample of faculty was re-interviewed via telephone. Subsections of the telephone interview were the same as those originally administered in the self-administered questionnaire. Reliability was calculated by comparing faculty telephone interview answers to those in the original survey. Of the 19 continuous variables tested, all produced reliability coefficients greater than .70. Questions with low reliability were either changed or removed.

Procedure

Though NSOPF is a public use data set available on the NCES website, some parts of the data are designated restricted use data. Restricted data were necessary for this study due to the nature of the dependent variable and the need to combine several measures into a single dependent variable measuring intention to leave. To successfully secure restricted data from

NCES, several steps were required. First, it was necessary for a professor located at the university where analysis was to take place to agree to be responsible for the data. Second, as the author of the research, it was necessary for me to be added as an authorized user of the data. This required a letter of intent for use of the data to NCES, as well as a signed and notarized affidavit of non-disclosure to ensure that sensitive information on participants would be protected. Finally, data were released to the primary professor on a password protected desktop computer.

Variables

Variables for this study will be selected from both the NSOPF faculty as well as the institution survey. A large number of independent variables will be included for study. These variables will be grouped into five groups. (a) personal characteristics, (b) institutional characteristics, (c) work characteristics, (d) job satisfaction and perceptions of working environment and (e) external variables. The dependent variable will consist of a single item asking how likely a faculty member would be to accept a position in or outside of the academy in the next three years. Responses range from "0" (not at all likely) to "4" (definitely likely).

Data Analysis

Using data from the NSOPF database, guided by the framework proposed by Zhou and Volkwein (2004), data were analyzed in four stages. First, data were cleaned and prepared for statistical analysis. More specifically, multiple imputation techniques were employed to account for missing cases where necessary, descriptive statistics were conducted to identify extreme cases and outliers, and skree plots and histograms were graphed to check for normality.

In the second stage of data analysis, preliminary descriptive statistics were run for all variables in the complete data set. Additionally, correlation analyses were conducted to determine the initial magnitude of and directional relationships between variables. This information provides preliminary evidence regarding which paths within the overall model to set.

In stage three, the preliminary (or null) models were developed. All variables, both exogenous and endogenous, were included based on previous work by Zhou and Volkwein (2004) (see table 1 for a full list of variables utilized in the study). Finally, data were entered into analytic software program, AMOS, and both statistical models (i.e., women in STEM and women in non-STEM) were tested using structural equation modeling techniques. The primary method of data analysis, structural equation modeling (SEM) was selected for several reasons.

First, SEM is regarded as an appropriate means to compare complex models to one another. Indeed, it is acknowledged as a superior method of data analysis to alternative approaches such as multiple regression, especially in situations where models involve a large number of linear equations, because it is able to produce summary evaluations and indices of fit. More simplistic techniques (e.g., regression), on the other hand, are only able to run separate tests of individual model components (Tomarken & Waller, 2005). Moreover, effective use of SEM techniques benefits from large sample sizes as well as a large number of variables (Tabachnick & Fidell, 2007; Velicer & Fava, 1998). Evaluation of the covariance matrix produced by the SEM analysis will answer research question one: What are the relationships between the constructs in Zhou and Volkwein's model and female faculty intention to leave. Research question two: Does the statistical model demonstrate better predictive validity for women faculty in STEM or non-STEM fields will be determined by examination of the chi-square statistic produced by the SEM analysis. From these statistics the researcher will be able to assess for which group, women in STEM or those in non-STEM fields, the model is a better fit. For these reasons, SEM was deemed the most appropriate method of analysis.

From the analysis, three indices were estimated for each model: (a) goodness of fit, (b) path coefficients of all significant paths or effects, and (c) proportion of variance explained by the model. These three indices were estimated for each model separately and then comparatively examined. Results of these analyses are detailed in chapter 4.

The proposed method of data collection and analysis provides a solid approach to investigating the relationship between the variables in Zhou and Volkwein's model of general faculty departure intentions to faculty departure intentions for women in STEM as well as non-STEM disciplines, and for determining whether the model more accurately represents pathways of departure intention for faculty women in STEM or non-STEM fields.

Chapter IV

Results

The purpose of this study is to test the relationships between variables in Zhou and Volkwein's (2004) model of faculty departure intentions and determine if the model "fits" departure intentions for women faculty in STEM and non-STEM fields. A combination of descriptive statistics and Structural Equation Modeling (SEM) techniques were employed to answer the two research questions that guided this inquiry. The research questions are as follows:

1. What are the relationships between the constructs and variables[2] presented in Zhou and Volkwein's (2004) model of faculty departure intentions and intention to leave for women faculty members in STEM and non-STEM fields?
2. Does the statistical model demonstrate better predictive validity for female faculty in STEM or non-STEM fields?

In this chapter, the results of the data analysis are presented and answers to the research questions provided. The chapter is organized into three parts. First, the steps taken to clean and code all data are detailed in the data preparation section. Second, the results of the final structural model and the answer to research question one are explained in the results of the final structural model section. Finally, the results of the comparison models for women faculty in STEM and for women faculty in non-STEM fields, as well as the answer to research question two, are presented in the results of the STEM and non-STEM comparative model section.

[2] The terms constructs and variables are used in accordance with Zhou and Volkwein's (2004) verbage and reflect the model design.

Data Preparation

Several steps were taken to prepare the data for analysis. Data were extracted from the NSOPF-99 data base provided by the National Center for Educational Statistics. Data for this analysis were pulled from both the faculty as well as the institutional NSOPF surveys. First, all variables to be used for analysis were identified from each survey and merged together to form a new working database. Item selection was based on guidance from the theoretical model framing the study, Zhou and Volkwein's (2004) model of faculty departure intentions.

Next, all items were cleaned and coded for analysis. Cleaning and coding were accomplished through a multi-step process. First, all items were coded for missing values. Missing cases were subsequently dropped from the analysis. Second, Zhou and Volkwein's (2004) model included several latent variables which were a composite of several items. In accordance with their theoretical model, the guiding framework for this study, factor analysis and item-reliability statistics were run for all multi-item variables. Although in some cases item-reliability fell below the threshold commonly recommended, the decision to proceed with using those items was made and justified in an effort to remain as true to Zhou and Volkwein's (2004) original model as possible. Table 1 shows a list of all multi-item variables as well as their corresponding items and item-reliabilities.

Third, as mentioned earlier, several restrictions were applied to the sample. The resulting sample included only women tenured or tenure-track faculty at four-year research or doctoral universities (N=1216). Finally, in order to appropriately determine the model fit, it is necessary to ensure that the tested model is as parsimonious as possible. Thus, the final model was reduced accordingly. That is, items which were not significant in preliminary analyses or which were

Table 1

Variables, items, and item reliabilities

Variable	Items	Chronbach's alpha
Satisfaction with workload		.62
	Satisfaction with time available to advise students	
	Satisfaction with time available for class prep	
	Satisfaction with work load	
	Satisfaction with time to keep current in field	
	Opinion of faculty workload increase	
Satisfaction with job security		.63
	Satisfaction with job security	
	Satisfaction with advancement opportunity	
Satisfaction with compensation		.70
	Satisfaction with salary	
	Satisfaction with benefits	
Satisfaction with job autonomy		.66
	Satisfaction with authority to decide course content	
	Satisfaction with authority to decided courses taught	
	Satisfaction with authority making other job decisions	
Satisfaction with resources		.90
	Rating of research equipment	
	Rating of laboratory space and supplies	
	Rating of available teaching assistants	
	Rating of available research assistants	
	Rating of computers and local networks	

Table 1. Continued

Variable	Items	Chronbach's alpha
	Rating of centralized computer facilities	
	Rating of internet connections	
	Rating of tech support for computers	
	Rating of audio visual equipment	
	Rating of classroom space	
	Rating of office space	
	Rating of studio/performance space	
	Rating of secretarial support	
	Rating of library holdings	
Perception of campus climate		.79
	Opinion about treatment of female faculty	
	Opinion about treatment of minority faculty	
Perceived institutional decline		.61
	Opinion of undergrad education at university	
	Opinion of atmosphere for expression of ideas	
	Opinion of quality of research at university	
	Opinion of full time replaced by part time faculty	
Scholarly productivity		.48
	Recent presentations	
	Recent works juris media	
	Recent reviews of works	
	Recent books/monographs	
Funded research		.66
	Total numbers of grants/contracts	
	Total funds from resources	

Table 1. Continued

Variable	Items	Chronbach's alpha
Teaching productivity		.60
	Total courses taught	
	Total classes taught	
	Hours a week teaching classes	
	Total students taught in credit classes	
	Total students taught non-credit classes	
Seniority/Career age		.88
	Years teaching in higher ed institution	
	Years in current position at institution	
	Age in 1999	

determined to not be related to intention to leave for women faculty were not included for analysis. The remainder of this chapter is devoted to providing the results of the statistical tests.

In total three different models were produced. Each tested Zhou and Volkwein's (2004) model of faculty departure intentions for one of three samples. First, the final structural model, which included all women in tenured, or tenure track positions, at four year research or doctoral institutions in all disciplines was tested. The results of the final structural model are presented below. The following section shows the results of the tests of Zhou and Volkwein's (2004) model of faculty departure for women in STEM and then compares these findings to the test of Zhou and Volkwein's (2004) model for women in non-STEM disciplines. Tables presenting the descriptive statistics of all variables included for analysis are provided and results of the tested SEM models are discussed further in the next two sections.

Results of the Final Structural Model Analysis

Descriptive statistics, including means and standard deviations, were calculated for all variables in the analysis. In this model all women, who were tenured or tenure track at four year research or doctoral institutions, regardless of discipline were included (N=1216). Table 2 presents the corresponding means and standard deviations for included variables.

After descriptive statistics were calculated and examined for possible outliers or deviations from normality, data were entered into AMOS for the structural equation model (SEM) analysis. All exogenous and endogenous variables were entered based on guidance from Zhou and Volkwein's (2004) model of faculty departure intentions. More specifically, faculty intention to leave was set as the dependent variable, and variables measuring types of job satisfaction and perceptions of environment served as latent predictors of intention to leave. Figure 1 shows the final structural model with all significant variables and coefficients included.

Table 2

Final Structural Model Descriptives

	M	*SD*
Intention to leave	.82	1.00
Satisfaction with job security	6.38	1.52
Satisfaction with workload	14.17	2.64
Satisfaction with compensation	5.61	1.57
Satisfaction with job autonomy	10.00	1.80
Satisfaction with available resources	34.94	9.18
Perceived campus climate	5.16	1.38
Perceived institutional decline	9.71	2.14
Minority	0.21	.41
Family/Marital status	2.79	1.21
Social economic status	4.71	2.08
Institutional control	1.22	.42
Institution size	4.75	.59

Table 2. Continued

	M	*SD*
Institution expenditure	4.98	.15
Institutional diversity	19.79	14.00
Percent unionized	19.28	37.11
Institutional consolidation	7.36	1.01
Child care availability	1.54	.50
Child tuition remission availability	1.41	.49
Paid maternity leave	1.27	.44
Hours worked per week	54.26	13.63
Total income from university	4.99	1.74
Academic rank	2.87	.81
Scholarly productivity	24.88	34.44
Funded research	164981.37	323049.36
Committee service	3.70	2.89
Seniority/Career age	73.69	24.91

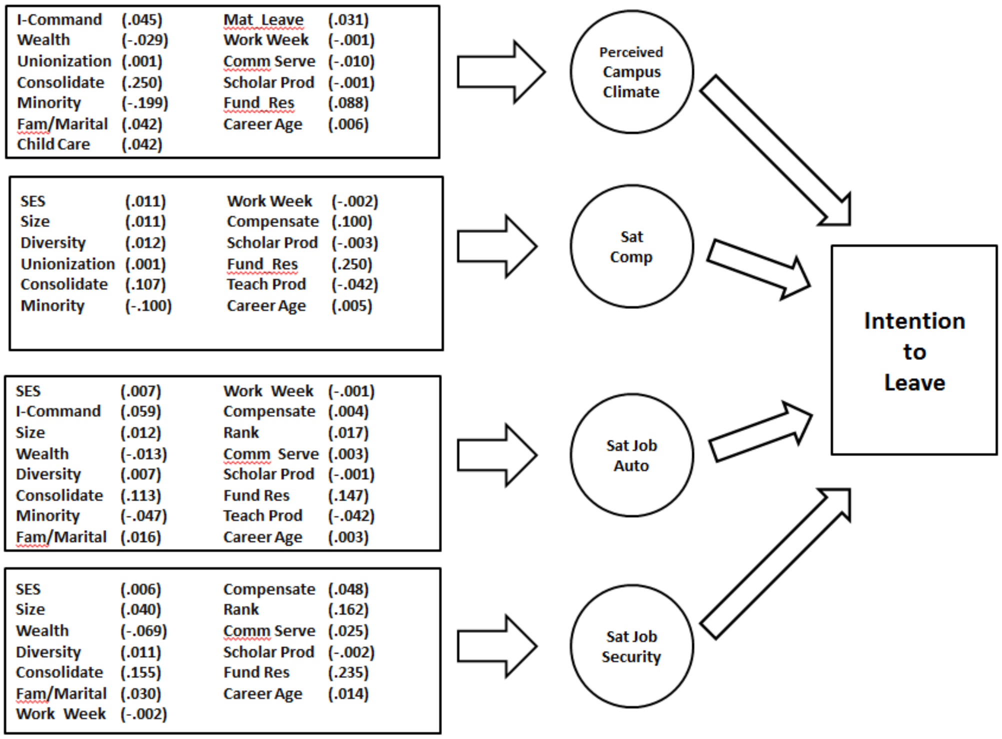

Figure 1. Final Structural Model of Female Faculty Intention to Leave

Findings of the Structural Model

The SEM analysis of the final structural model was designed to answer research question one: What are the relationships between the constructs and variables presented in Zhou and Volkwein's (2004) model of faculty departure intentions and intention to leave for women faculty members in STEM and non-STEM fields? In order to effectively accomplish this goal, the data were entered into AMOS and specified according to Zhou and Volkwein's model design. Prior to examining specific relationships, the over-all fit of the final structural model was determined by an examination of the chi-square statistic in conjunction with two other statistical tests (Hoelter, 1983; Long, 1983). The Chi-square statistic for the final structural model was 145030.961, $p < 0.001$. A significant chi-square indicates that the model is not a good fit of the data (Byrne, 2009). Additionally, two other tests of model fit were used in conjunction with the Chi-Square statistic, as recommended by SEM experts (Raykov & Marcoulides, 2000). These two tests were the RMSEA test and the CFI test. A RMSEA of .07 or below is considered to be indicative of "adequate" model fit. Similarly, a CFI value of .90 or greater would also indicate "acceptable" fit of the model to the data. For the final structural model in this analysis, the RMSEA value was .069, and the CFI value was .541. Although the RMSEA value is approaching the desired level for adequate model fit, the CFI value indicates poor fit of the model to the sample data from women faculty. Collectively, these statistics suggest that Zhou and Volkwein's (2004) model of faculty departure intentions is inadequate for women faculty. Although the model may not fit on the whole, still information about the relationships of specific variables to intention to leave for women faculty may be further examined as significant pathways may warrant further discussion. Thus, to answer research question one and specifically determine the relationship between the constructs and variables presented in Zhou and Volkwein's (2004) model of faculty departure intentions and intention to leave for women faculty members in STEM and non-STEM fields, model estimates, or path co-efficients and their corresponding significance levels were examined.

Intention to leave for all women in STEM and non-STEM disciplines.

Intention to leave served as the dependent outcome variable for this analysis. In the final structural model, several variables were directly and inversely related to intention to leave. These variables, in order of magnitude, included *satisfaction with job autonomy* (-.252), *satisfaction with compensation* (-.248), *satisfaction with job security* (-.181), and *perception of campus climate* (-.165). In essence, women faculty who were less satisfied with their job autonomy, compensation levels, job security, or who had lower perceptions of campus climate with regards to gender or race were more likely to report intentions to leave their current position.

Moreover, several variables had significant indirect effects on intention to leave for women faculty; that is, they influenced intention to leave through the one or more of the four (mediating) variables mentioned above. These indirect variables, in order of magnitude, were *Funded Research* (.72), *Institutional Consolidation* (.625), *Minority* (-.346), *Rank* (.179), *Institutional Command* (.104), *Compensation* (.152), *Wealth* (.111), *Family/Marital Status* (.088), *Teaching Productivity* (.084), *Size* (.063), *Child Care* (.042), *Maternity Leave* (.031), *Diversity* (.03), *Career Age* (.028), *Social Economic Status* (.024), *Committee Service* (.038), *Scholar Productivity* (-.007), *Work Week* (-.006), and *Unionization* (.002). The largest indirect influence on women faculty's intention to leave was *funded research*, which was related to intention to leave through all four directly related variables. That is, women faculty who had higher levels of funded research also reported being more satisfied with their job security, job autonomy, compensation, and had better perceptions of campus climate. These higher levels of satisfaction, in turn, rendered them less likely to report intentions of leaving the current job.

These findings answer research question one, and suggest that several variables in the model have a significant indirect or direct effect on intention to leave for women faculty, although the overall model is poor in terms of its "fit" for women faculty. Of all factors studied, satisfaction with job autonomy had the largest direct effect on intention to leave for women faculty (B =-.252), followed by satisfaction with compensation, satisfaction with job security, and perceptions of campus climate.

Results of the STEM and non-STEM Comparative Model Analysis

Several steps were taken to answer the second research question, which asked if the hypothesized model had better predictive validity for women faculty in STEM or in non-STEM disciplines. First, the original sample of women tenured or tenure-track faculty in four year research or doctoral institutions was further split by discipline. Using Biglan's (1973) discipline classification system, women were divided and placed in either the STEM or non-STEM discipline group for analysis. The resulting sample size was 253 for the STEM group and 963 for the non-STEM group. The final structural model was then used to conduct two separate analyses: one for women in STEM and another for women in non-STEM disciplines. In this section, the findings of the STEM model will be presented, followed by the findings of the non-STEM model. Finally, the two models will be compared to each other to answer research question two: does the model have better predictive validity for women in STEM or non-STEM disciplines?

Findings of the STEM Model

To begin, descriptive statistics for all variables included in the STEM model were run. Table 3 shows the means and standard deviations for all STEM model variables. After descriptive statistics were run, data were imported into AMOS for SEM analysis (Byrne, 2009). Both the STEM and non-STEM models utilized the final structural model so that model fit could effectively be assessed and compared. As previously explained, three measures of model fit were also tested for the STEM and non-STEM models. These statistics included: (a) the chi-square statistic, (b) the RMSEA, and the (c) CFI. The overall chi-square statistic value for the STEM model was 28786.6 ($p<0.001$), indicating poor model fit. The RMSEA value was 0.068 and the CFI value was 0.563. As with the previous model, the RMSEA value for the STEM sample also approaches the threshold for "acceptable" model fit, however, the CFI value indicates inadequate fit of the model to the sample data. Taken together, these statistics suggest that the model is inadequate for fitting to the data from women faculty in STEM fields.

After the model fit was assessed, path estimates were examined for significant pathways and variable relationships. The STEM model with its corresponding significant path coefficients is presented in figure 2.

Findings from the overall Model of Intention to Leave for Female Faculty in STEM suggest that similar to the final structural model (presented in the previous section), several variables were directly and indirectly related to intention to leave for women faculty in STEM. Specifically, four variables had direct inverse relationships with female STEM faculty intention to leave. These variables, in order of magnitude, were *satisfaction with compensation* (-.288), *satisfaction with job autonomy* (-.175), *satisfaction with job security* (-.174), and *perceived campus climate* (-.163). These findings suggest that women faculty in STEM fields who are

Table 3

STEM Model Descriptives

	M	*SD*
Intention to leave	0.838	0.973
Satisfaction with job security	6.23	1.58
Satisfaction with workload	14.15	2.60
Satisfaction with compensation	5.70	1.46
Satisfaction with job autonomy	9.91	1.75
Satisfaction with available resources	32.77	8.21
Perceived campus climate	5.19	1.29

Table 3. Continued

	M	*SD*
Perceived institutional decline	9.34	2.13
Minority	0.23	.42
Family/Marital status	3.05	1.14
Social economic status	5.06	2.12
Institutional control	1.25	.43
Institution size	4.75	.54
Institution expenditure	4.99	.11
Institutional diversity	20.19	14.16
Percent unionized	16.03	34.11
Institutional consolidation	7.50	.53

Table 3. Continued

	M	*SD*
Child care availability	1.55	.50
Child tuition remission availability	1.45	.50
Paid maternity leave	1.25	.44
Hours worked per week	56.00	11.24
Total income from university	5.48	1.90
Academic rank	2.82	.81
Scholarly productivity	27.10	31.71
Funded research	239443.05	369051.30
Committee service	3.26	2.37

Table 3. Continued

	M	*SD*
Seniority/Career age	66.77	22.43

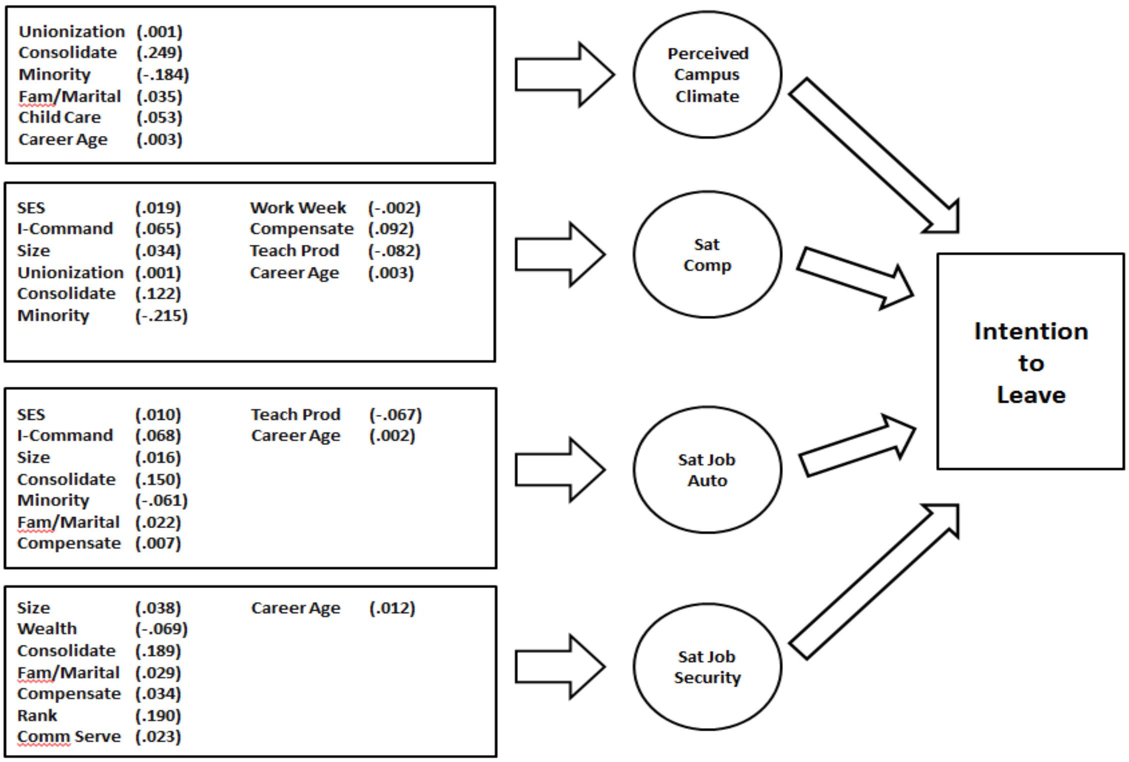

Figure 2. Model of Intention to Leave for Female Faculty in STEM Disciplines

more satisfied with their compensation, job autonomy, job security, and have better perceptions of campus climate, are less likely to have intentions of leaving.

From the SEM analysis, several variables were also identified as having an indirect effect on STEM women's intention to leave. That is, these variables were related to intention to leave through one or more of the four mediating variables which were directly related to intention to leave. These variables included *Institutional Consolidation* (.710), *Minority* (-.460), *Academic Rank* (.190), *Teaching Productivity* (.149), *Compensation* (.133), *Institutional Command* (.133), *Size* (.088), *Family/Marital Status* (.086), *Wealth* (-.069), *Child Care* (.053), *Social Economic Status* (.029), *Committee Service* (.023), *Career age/Seniority* (.020), *Work Hours* (-.002), and *Unionization* (.001).

Findings of the Non-STEM Model

Analysis of the non-STEM model proceeded in the same way as the analysis for the STEM model. First, the sample was restricted to include only women tenured or tenure-track faculty employed in a four year research or doctoral institution. The resulting sample included 963 participants. Second, descriptive statistics, including means and standard deviations, were calculated for all variables in the non-STEM model. Table 4 presents these descriptive statistics for the non-STEM model.

Finally, data were entered into AMOS for the SEM analysis of the non-STEM model. Following the same data analysis procedure that was detailed earlier, first model fit statistics were assessed. The resulting value of the chi-square statistic for the non-STEM model was 119966.7 ($p<0.001$). The value of the RMSEA was 0.071 and the CFI was 0.532. Together these statistics suggest that the model is not a good fit of the data for women faculty in non-STEM fields.

Table 4

Non-STEM Model Descriptives

	M	*SD*
Intention to leave	0 .81	1.00
Satisfaction with job security	6.42	1.50
Satisfaction with workload	14.17	2.65
Satisfaction with compensation	5.58	1.59
Satisfaction with job autonomy	10.02	1.82
Satisfaction with available resources	35.41	9.35
Perceived campus climate	5.15	1.40
Perceived institutional decline	9.80	2.13

Table 4. Continued

	M	*SD*
Minority	0.21	0.41
Family/Marital status	2.72	1.22
Social economic status	4.61	2.06
Institutional control	1.22	0.41
Institution size	4.75	0.61
Institution expenditure	4.98	0.16
Institutional diversity	19.68	13.96
Percent unionized	20.13	37.84

Table 4. Continued

	M	*SD*
Institutional consolidation	7.34	1.07
Child care availability	1.54	0.50
Child tuition remission availability	1.39	0.49
Paid maternity leave	1.27	0.45
Hours worked per week	53.81	14.16
Total income from university	4.86	1.67
Academic rank	2.88	0.81
Scholarly productivity	24.30	35.11
Funded research	133147.63	296073.28

Table 4. Continued

	M	*SD*
Committee service	3.82	3.00
Seniority/Career age	75.50	25.22

After the model fit indices were calculated and interpreted, path coefficients were examined to determine variable relationships. The non-STEM model, with accompanying significant path coefficients, is included in figure 3.

Findings from the non-STEM model suggest that four variables had a significant direct and inverse relationship with intention to leave for women faculty in non-STEM disciplines. These variables, in order of magnitude, were *satisfaction with job autonomy* (-.263), *satisfaction with compensation* (-.244), *satisfaction with job security* (-.188), and *perception of campus climate* (-.160). These findings suggest that for women faculty in non-STEM disciplines those who are more satisfied with their job autonomy, compensation, and job security, and who have better perceptions of the campus climate are less likely to leave.

In addition to the direct relationships found in the SEM analysis, several variables were also identified as having an indirect effect on non-STEM women's intention to leave. That is, these variables were related to intention to leave through one or more of the four mediating variables which were directly related to intention to leave. These variables included *Institutional Consolidation* (.656), *Minority* (-.229), *Compensation* (.186), *Academic Rank* (.176), *Institutional Command* (.158), *Family/Marital Status* (.105), *Wealth* (-.086), *Size* (.085), *Teaching Productivity* (.085), *Child Care* (.049), *Social Economic Status* (.037), *Paid Maternity Leave* (.037), *Committee Service* (.035), *Career age/Seniority* (.024), *Research Productivity* (-.007), *Work Hours* (-.006), and *Unionization* (.002), *Diversity* (-.001). It is important to note that the last four variables have a near negligible effect, although the path is statistically significant which is likely due to the large sample size (Byrne, 2009).

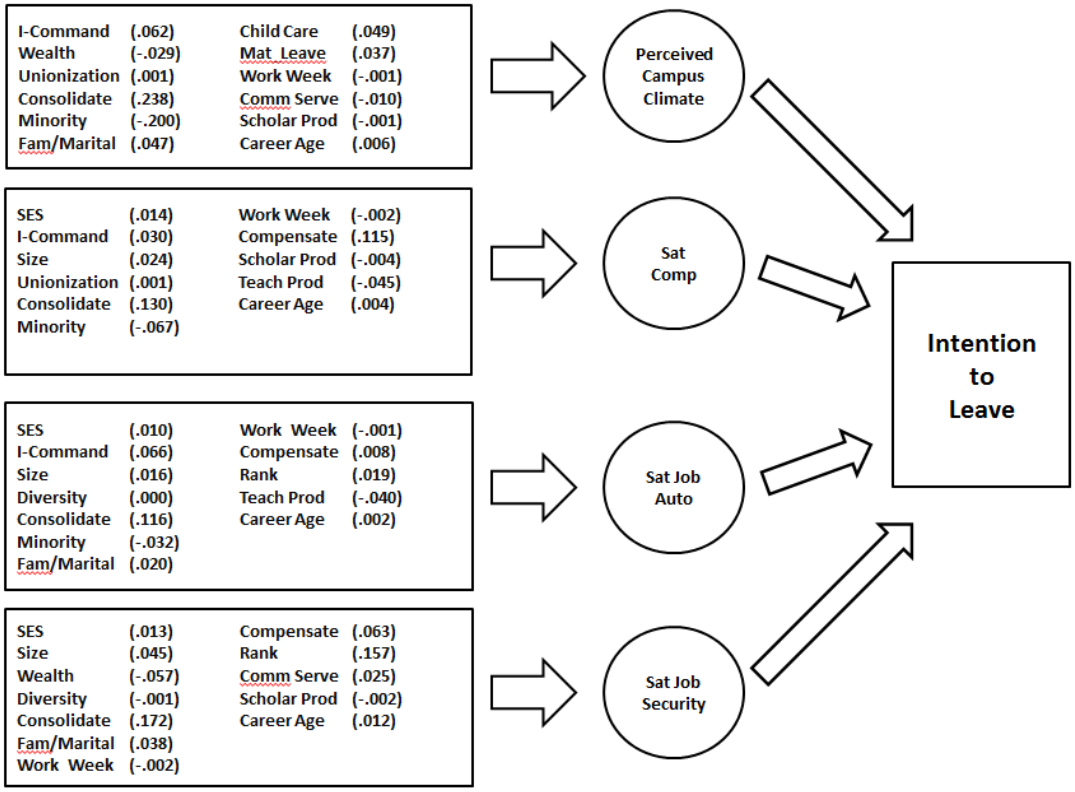

Figure 3. Model of Intention to Leave for Female Faculty in non-STEM Disciplines

Comparison of the Models of STEM and Non-STEM

To effectively answer research question two, which asked if the statistical model demonstrated better predictive validity for female faculty in STEM or non-STEM fields, it is necessary to examine and compare the squared multiple correlations for both the STEM and non-STEM model. The squared multiple correlation estimate for the STEM model was 0.143 indicating that 14.3% of the variance in intention to leave for women in STEM is explained by the model. For the non-STEM model the squared multiple correlation estimate was 0.154 indicating that the model explained 15.4% of the variance in intention to leave for women in non-STEM disciplines. Therefore, results of this comparative analysis suggest that the statistical model explains more of the variance and has more predictive validity for women in non-STEM disciplines than it does for women in STEM.

Conclusion

This chapter presented the results of the data analysis. Findings from the SEM analysis, including overall model fit indices and path estimates, were provided. Included in the data presentation were the answers to the guiding research questions of this study. Discussion of these findings and implications for practice, policy, and future research are presented in Chapter 5.

Chapter V

Summary, Discussion, and Conclusions

Retaining women in faculty positions, particularly in fields where they are underrepresented (i.e., STEM fields) remains an important goal of many educational stakeholders. Over the past decade much warranted attention has been given to the problem of increasing women in STEM as it is well-recognized that in order to remain globally competitive the United States must continue to recruit and retain all potential talent in STEM fields (Brainard, 2008; Schmidt, 2007). This study addresses one critical component of the educational pipeline, retention of women faculty in STEM fields.

Several scholars have studied faculty departure patterns and created causal models of faculty departure intentions (Smart, 1990; Matier, 1990; Zhou & Volkwein, 2004). However, in terms of looking at the retention of women in STEM, these models are limited since they look at faculty as a whole, rather than by gender or discipline. The purpose of this research is to test the relationships between variables in Zhou and Volkwein's (2004) model of faculty departure intentions and determine if the model "fits" departure intentions for women faculty in STEM and non-STEM fields.

This study used national data from the National Study of Postsecondary Faculty to test an existing model of faculty departure intentions posited by Zhou and Volkwein (2004) on a sample of women faculty in STEM and non-STEM fields. The original sample was restricted to include only tenure or tenure track women in four year research or doctoral institutions. The resulting sample for the final structural model was 1216.

Two research questions guided this study. The first asked about the relationships among the variables and constructs presented in Zhou and Volkwein's (2004) model. The second, inquired about for which group, women in STEM or those in non-STEM, the model demonstrated better predictive validity. To answer these questions, a combination of descriptive statistics and Structural Equation Modeling techniques were employed.

The remainder of this chapter is organized into five sections. First, a summary of the findings is presented. This is followed by a discussion of the findings and conclusions, limitations of the study, and recommendations for practice, theory, and future research.

Summary of Major Research Findings

This study produced three major findings, which are summarized below.

1. Four of the six hypothesized variables in the final structural model were significantly related to intention to leave for women faculty. These variables were *satisfaction with job autonomy*, *satisfaction with compensation*, *satisfaction with job security*, and *perceived campus climate.* In addition to the direct relationships, 19 variables were indirectly related to intention to leave for female faculty. These variables included: *Institutional Command*, *Funded Research*, *Institutional Consolidation*, *Minority*, *Rank*, *Compensation*, *Wealth*, *Family/Marital Status*, *Teaching Productivity*, *Size*, *Child Care*, *Maternity Leave*, *Diversity*, *Career Age, Social Economic Status*, *Committee Service*, *Scholar Productivity*, *Work Week*, and *Unionization.* Taken together, these findings answer research question one: What are the relationships between the constructs and variables in Zhou and Volkwein's (2004) model and intention to leave for women faculty.

2. The squared multiple correlation value for the STEM model was .143, indicating that the model accounted for 14.3% of the variance in intention to leave for women in STEM. The squared multiple correlation value for the non-STEM model was .154, indicating that 15.4% of the variance in intention to leave for women in non-STEM disciplines was explained by the model. These findings answered research question two which asked about for which model women in STEM or in non-STEM the model had better predictive validity. These findings suggest that the model had slightly better predictive validity for women in non-STEM fields.

3. For model one (i.e., the final structural model tested on women faculty) the Chi-square statistic was 145030.961, $p < 0.001$, the RMSEA value was .069, and the CFI value was .541. For model two (i.e., women in STEM) the Chi-Square statistic was 28786.6 ($p<0.001$), the RMSEA value was 0.068, and the CFI value was 0.563. Finally, for model three (i.e., women in non-STEM) the Chi-Square statistic was 119966.7 ($p<0.001$), the RMSEA was 0.071, and the CFI was 0.532. These model fit indices suggest that none of the three models tested demonstrated good model fit of the data.

Discussion of the Findings

The first research question asked about the relationship of the variables presented in Zhou and Volkwein's (2004) model of faculty departure intentions for female faculty in STEM and non-STEM fields. The finding that *satisfaction with job autonomy*, *satisfaction with compensation*, *and satisfaction with job security* were directly and inversely related to intention to leave is consistent with a wealth of previous research, which suggests that job satisfaction is directly related to intention to leave (Johnsrud & Rosser, 2002; Rosser, 2004; Smart, 1990; Zhou & Volkwein, 2004). Moreover, the same direct relationships between the three dimensions of job satisfaction and intention to leave for general faculty that were observed in this study were also found in Zhou and Volkwein's (2004) research for all faculty in all disciplines. Given that previous literature consistently shows an inverse and direct relationship between satisfaction and intention to leave, these findings were not surprising. More curious, however, is the lack of a significant relationship to intention to leave for the two other dimensions of satisfaction that were tested, *satisfaction with resources* and *satisfaction with workload.* It is plausible that because satisfaction with one's current situation is often a reflection of an assessment of another's situation that is different or better than one's own, that women faculty might not perceive the workload or available resources at other institutions to differ much from their own. In this way, workload and available resources may have less of an impact on their intentions to leave than satisfaction with job security, compensation, or autonomy which they may perceive as better for other faculty at different institutions.

Additionally, in this study, *perception of campus climate* was also directly related to intention to leave for women faculty. Interestingly, of the four variables demonstrating a direct relationship with intention to leave, *perception of campus climate* was the only variable that was not observed in Zhou and Volkwein's (2004) study. In other words, while low levels of satisfaction with job security, job autonomy, and compensation may be indicative of intentions to leave for faculty in general, perceptions of campus climate may be predictive of intention to leave only for women faculty.

While interesting, these findings are not necessarily surprising. Several studies that have examined reasons for women's underrepresentation in faculty, particularly in STEM fields, have pointed to the "chilly campus climate" as a possible source of discontent amongst female faculty (Grant, Kennelly, & Ward, 2000; Rosser, 2004; Sonnert & Holton, 1996). The findings from this study linking *perceived campus climate* to intentions to leave for women faculty may serve as further indication that overall campus climate may be of importance for women, who may feel that they fall victim to gender discrimination or harassment in a hostile campus climate.

In addition to the direct predictors of intention to leave, 19 variables were indirectly related to the outcome variable. Though these indirectly related variables account for a significant portion of the variance explained in the model, that outcome is largely due to the sheer numbers of significantly related variables. It is important to note that each one, individually, is only weakly and indirectly related to intention to leave. The weak relationships of large numbers of variables found in this study are similar to the findings of other causal models of faculty departure, including Zhou and Volkwein (2004) and Smart (1990). It is possible that faculty departure patterns are so complex in nature that beyond satisfaction there are no factors that researchers can point out to explain a large portion of the variance in intention to leave. Another explanation, however, might be that current faculty surveys are not asking the right questions to obtain the information most important in influencing faculty departure. Finally, it is plausible that reasons for departure vary so much for sub-groups of faculty that it is not appropriate to study them even by obvious grouping patterns such as gender or discipline alone.

The second research question asked if the hypothesized statistical model had better predictive validity for female faculty in STEM or non-STEM fields. The findings suggested that the model demonstrated slightly better predictive validity for women in the non-STEM sample. There were several aspects of this finding worth discussion.

Predictive Validity Comparison

Overall, the answer to research question two was the model had only slightly better predictive validity for women in the non-STEM fields than the STEM fields. From existing literature, which suggests that women in STEM might face challenges that are above and beyond women faculty in other fields where they are better represented (Callister, 2006; Grant, Kennelly, & Ward, 2000; Rosser, 2004; Sonnert & Holton, 1996), it is curious that there was not more of a difference between predictive validity of intention to leave in the STEM and non-STEM models. This may be indicative of a need to further separate women not only by discipline but also by other grouping patterns such as gender and discipline or tenure and non-tenure.

STEM vs. Non-STEM Variable Comparisons

The four variables that were identified as direct significant predictors of intention to leave in the final structural model were also direct significant predictors of intention to leave in both the STEM and non-STEM models. These variables were *satisfaction with job autonomy*, *satisfaction with compensation*, *satisfaction with job security*, and *perceived campus climate.* There was, however, a slight difference between the STEM model and the non-STEM model. For women in STEM the variable with the strongest direct relationship to intention to leave was *satisfaction with compensation*, whereas in the non-STEM model, the variable with the strongest direct relationship was *satisfaction with job autonomy.* That is, for women in STEM, feeling more satisfied with their salary and benefits may be the best way to entice them to stay, whereas for women in non-STEM, the flexibility to choose the types and number of classes taught may be the best way to increase the chances of staying in their current position. This is consistent with literature which describes the culture of STEM departments as masculinized, and in stereotypically masculinized fields, salary drives competition (Callister, 2006; Rosser, 2004; Settles et al., 2006; Sonnert & Holton, 1996). Women in STEM fields may feel pressure to conform to the male norms of their discipline, including placing emphasis on compensation. These findings, however, contradict those of Xu's (2008) study of gender differences in turnover intentions for STEM faculty. Xu (2008) found that significant predictors for women and men in STEM differed. More specifically, while satisfaction with salary was one of the top predictors of turnover intentions for men in STEM, free expression of ideas and opportunity for advancement were two predictors significantly related to intention to leave for women in STEM. It is unclear why these results are inconsistent. One explanation might be that in this study the variable studied was satisfaction with compensation, which is a composite of salary and benefits, whereas in Xu's (2008) study the variable studied was satisfaction with salary alone. It is possible that for women in STEM, benefits associated with their position play a large role in their overall satisfaction with compensation, which may be influencing their intentions to leave.

In this study three benefits that were considered to be of particular importance for women in STEM and non-STEM disciplines were studied outside of the general grouping of satisfaction with compensation. These benefits variables were *child care availability*, *child tuition remission*, and *paid maternity leave*. The decision to look at these benefits individually was made, in part, due to the number of studies which point out that availability of these types of benefits may be of particular importance to women faculty regardless of discipline (Grant, Kennelly, & Ward, 2000; Rosser, 2004). Thus, these variables were included individually and pulled out for comparison between women in STEM and those in non-STEM fields. Interestingly, of the three women's benefit variables, only child care availability was a significant indirect predictor of intention to leave for both women in STEM and in non-STEM fields. Child tuition remission did not significantly impact intention to leave for either group. Paid maternity leave availability, on the other hand, was a significant predictor of intention to leave only for female faculty in non-STEM disciplines. The finding that paid maternity leave was only significant for non-STEM women faculty might be explained by several qualitative research studies in which female faculty in STEM fields report feeling that taking maternity leave stigmatizes them in some way, so they tend not to use the benefit (Blakewood & Sallee, in review; Grant, Kennelly and Ward, 2000). Therefore, considering female faculty in STEM fields may be less inclined to make use of paid maternity leave, regardless of its availability, it may have less of an effect on their perceptions of campus climate than for their non-STEM counterparts.

With respect to the question of model fit, as reported earlier, none of the three models tested (i.e., women faculty, women in STEM, or women in non-STEM) were good fits of the data. Considering the empirical grounding of the models of faculty departure, including Zhou and Volkwein (2004) and Smart (1990), the lack of model fit for women faculty and for those in non-STEM disciplines was not expected. However, given the literature on women in STEM suggesting that women in these disciplines face challenges that are above and beyond that of women faculty in other disciplines, the lack of model fit was as expected for the STEM group. The lack of model fit for all three groups may point out that studying women in general with current models of faculty departure may not be appropriate. It may also be, as noted previously, that current faculty surveys are not asking appropriate questions to accurately understand issues for women faculty in general.

Limitations and Delimitations

A few limitations/delimitations arose during the analyses that warrant mention. First, as mentioned earlier, in some cases, item reliabilities were not as high as commonly suggested for formation of a single construct. However, given the purpose of the study, the decision to proceed in combining items into a single construct was made. Second, the original model posited by Zhou and Volkwein (2004) would not converge to produce the calculated estimates. Thus, a decision to proceed by running the model in pieces and deleting non-significant pathways was made to reduce the model to form the final structural model. In other words, although, ideally, for this study, the final structural model would be identical to Zhou and Volkwein's model, the trimming process was necessary to ensure parsimony and feasibility. Despite these limitations, the final model tested in this study is an accurate reflection of Zhou and Volkwein's (2004) model and maintains a structure similar enough to accurately test their model.

Implications for Practice, Theory, and Future Research

The purpose of this study was to test the relationships between variables in Zhou and Volkwein's (2004) model of faculty departure intentions and determine if the model "fits" departure intentions for women faculty in STEM and non-STEM fields. The analysis indicated that though there were several significant relationships between the variables included in analysis and intention to leave, the overall fit of the Zhou and Volkwein (2004) model was not a good fit for (a) women faculty in general, (b) women faculty in STEM fields, or (c) women faculty in non-STEM fields. Given the problem of increasing the number of women in the academy, and specifically in STEM fields, it is clear that new models of departure intentions need to be conceptualized and tested for women faculty and for those specifically in STEM fields. Keeping the findings of this study in mind, implications for practice, policy, and future research are discussed.

Implications for Practice

Findings from this study have several practical implications for various educational stakeholders. First, loss of faculty and ensuing faculty replacement searches can be costly and time consuming, thus it remains an important goal of deans and department heads to retain faculty. Retaining women faculty becomes a particularly important goal in disciplines where there are few women to begin with. Findings from this study give insight into factors, which may be important predictors of intention to leave for women in STEM and non-STEM disciplines. Based on this research, deans or department heads that wish to retain women faculty in STEM disciplines might consider increases in salary or benefits, as this study suggests that satisfaction with compensation has the strongest direct relationship to departure intentions. That is, women who are compensated monetarily are more likely to be satisfied and therefore less likely to leave. For women in non-STEM disciplines, administrators might consider providing them with more job autonomy, as the freedom to choose the types and times of the classes taught was found to be the strongest predictor of intentions to leave for women in non-STEM fields. In other words, women faculty who had more choices in their class teachings, were more satisfied with their job autonomy and were less likely to leave.

Implications for Theory and Future Research

In addition to practice, this study also has implications for theory and future research. One of the major findings of this research is that current models of faculty departure intentions may not be appropriate for women faculty, regardless of their discipline. It is clear, based on this finding, that new models of departure intention need to be conceptualized and tested, taking into account the needs of women in particular. To this end, several suggestions for future research are offered. First, considering it is not clear if current faculty surveys are asking appropriate questions to create models to explain departure intentions for women, future studies might employ qualitative methodologies to gain more insight into the challenges, supports, and experiences of women faculty. Then, future quantitative researchers might use SEM techniques to develop and test causal models of faculty departure for women in general. Once a model of good fit has been designed for women faculty, a third study might test for disciplinary differences between women in STEM and non-STEM fields. Additionally, future researchers might consider breaking faculty down further and studying intention to leave by gender, discipline, tenure-status, and/or minority status. If these recommendations for practice, theory, and future research are pursued, educational stakeholders may be able to better predict departure patterns for women faculty both in STEM and non-STEM disciplines.

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Appendix A

Zhou and Volkwein's (2004) Model of Faculty Departure Intentions

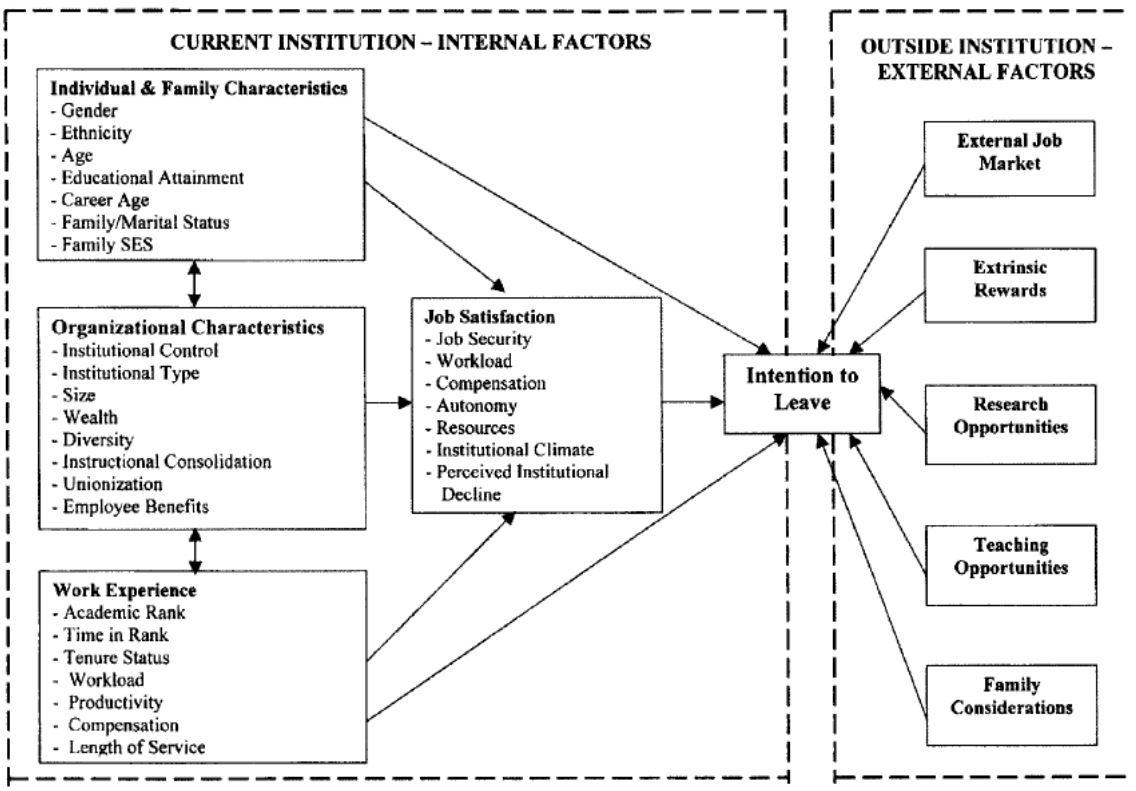

FIG. 1. The Theoretical Model of Faculty Departure.

Vita

Amanda M. Blakewood was born in Gainesville, FL to Stephen and Sally Blakewood. She was born and raised in Gainesville FL, after which she moved to Orlando, FL to attend the University of Central Florida where she earned a Bachelors of Arts degree in Psychology. Following her graduation Amanda attended the University of Tennessee in Knoxville, TN where she earned her Masters of Science in College Student Personnel and subsequently a certificate in Quantitative Research Methods and her Ph.D. in Higher Education Administration. She has presented at over 20 national and international conferences and authored several refereed journal articles and book chapters. She currently lives in Jacksonville, FL with her husband, Dan and serves at the Associate Director of Admissions at the University of North Florida.