Engineering A Place for Women: A Study of How Departmental Climate Influences the Career Satisfaction of Female Mechanical Engineering Faculty Members

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ABSTRACT

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Engineering Faculty Members

The purpose of this mixed-methods study was to better understand how female

mechanical engineering faculty members' career experiences in academia affect their

satisfaction. Specifically, the research considered differences in satisfaction reported by female

and male mechanical engineering faculty members in terms of: a) departmental climate, b) nature

of work, c) resource allocations, d) departmental policies/practices, and e) overall satisfaction.

The study compared the levels of satisfaction reported in survey data collected from 2005-2010

with interview data collected from a subset of the survey population. The survey sample

included 237 mechanical engineering faculty members who responded to an online survey

developed by the Collaborative on Academic Careers in Higher Education (COACHE). A subset

of the survey participants was interviewed to gain nuanced descriptions of faculty member work-

life in order to refine the quantitative analysis. The interview sample included 28 faculty

members from ten institutions across the U.S. The study used chi-square analyses to compare

the survey responses of female and male mechanical engineering faculty members, and in some

cases to compare the survey responses by academic rank. Themes were developed from the

interview data and the theory of gendered organizations was used to give perspective on the

analyses.

The results of this study identified the role of gendered divisions of labor, gendered

divisions of allowed behavior, gendered symbols, and gendered interactions as reasons why

female mechanical engineering faculty members are less satisfied than their male colleagues with

employment in academia and the nature of their work. Recommendations for how mechanical

engineering leadership can improve the climate in the department include transparency in

decision-making, leading by example, increasing empathy toward colleagues, and encouraging

senior faculty members to engage in constructive and collaborative research conversations with

junior faculty members.

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Engineering Faculty Members

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CHAPTER 1: INTRODUCTION

National attention continues to focus on the role of engineering and technology in refueling the economy in the United States. In the widely publicized report, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future,* (i.e., Gathering Storm Report) the authors suggest that "without high-quality, knowledge-intensive jobs and the innovative enterprises that lead to discovery and new technology, our economy will suffer and our people will face a lower standard of living" (National Academy of Science [NAS], 2007, p. 1). As a result of the legislation and funding by the U.S. government after the Gathering Storm Report was released, a subsequent report assessed the implementation of the Gathering Storm Reports' recommendations. This follow up report found that "our nation's outlook has worsened," largely due to the U.S.'s increasing national debt and innovation must be fostered in order for the U.S. to prosper (NAS, 2010, p. 4). The increased outsourcing of engineering and technology jobs to foreign countries requires the United States to make changes in the current system and invest significantly in science, technology, engineering, and mathematics (STEM) education in order to maintain its prominence and leadership in the advancement of scientific and technological knowledge. For decades, excellence in building and sustaining institutions of higher education that attract science and engineering talent from all over the world has defined this nation, but other countries have been working diligently to catch up. As the number of respected institutions of higher education increases across the globe, the field of candidates for faculty positions will become more limited. This is particularly important in engineering fields where the number of doctoral degrees awarded from universities in the United States has increased from just over 5000 in 2002 to 7900 in 2009, but not because of increased numbers of U.S. citizens completing the degree, rather a 60% increase in the international student population

(National Science Board [NSB], 2012). With the limited supply of U.S. doctoral candidates available for faculty positions at U.S. institutions, a concerted effort is needed to both increase the number of individuals who *pursue* a career in academia in STEM fields as well as *retain* new faculty members, particularly in engineering. Women may have different life experiences and different interests than men, thus providing different perspectives on methods to provide solutions for the pressing issues in STEM research areas. Supporting the potential of women, underrepresented minorities, and persons with disabilities in STEM research and education must be a priority for the United States to continue to be competitive globally and prosper (National Science Foundation [NSF], 2004).

Engineering as a field has suffered most seriously from the shortage of women entering and advancing through the STEM education pipeline. The National Science Board (2012) in its recent *Science and Engineering Indicators 2012* reported that, although the percentage of women earning doctoral degrees in engineering fields has increased from a low of 6% in 1985, women still lag far behind men in doctoral degrees in engineering, comprising just 22% of total degrees awarded (NSB, 2012). In contrast, women account for 47% of doctoral degree awardees in all areas of science and engineering combined, and 51% of doctoral degree awardees in all subject areas (NSB, 2012). At earlier levels of education, these numbers are comparable, where the percentage of women completing masters and bachelors degrees in engineering in 2009 was 15 and 11 percent, respectively (NSB, 2012). The percentage of female mechanical engineering bachelors degree recipients began dropping off in 2007 after reaching a high of 14% in 2000. The attrition of women as compared to men on the path to the Ph.D. results in the ever-widening gap in the numbers of women achieving advanced academic positions in STEM disciplines causing an overall ripple effect on future generations (McIlwee & Robinson, 1992).

Statement of the Problem

In the two largest fields of engineering, mechanical and electrical/computer, the percentage of female tenured or tenure-track faculty members in the United States are 10.1 and 11.2 percent, respectively. Given that there are over 4,200 teaching personnel in each of these fields teaching an undergraduate population of 96,164 mechanical and 77,270 electrical engineering students, the scant number of women faculty members in these disciplines does not make sense (American Society of Engineering Education [ASEE], 2010). To visualize the stark contrast with other fields in engineering, Figure 1 shows the faculty member numbers in each field of engineering broken down by gender and Figure 2 shows the percentage of female faculty members in each field.

These figures show that only three fields have a lower percentage of female faculty members than mechanical engineering, and two of these fields are specialized sub-fields of mechanical engineering—aerospace and nuclear. After combining the sub-fields of aerospace and nuclear with the field of mechanical engineering it is clear that the problem of extremely low numbers of female faculty members is most prevalent in the field of mechanical engineering.

Figure 1. Number of engineering faculty members by discipline and gender
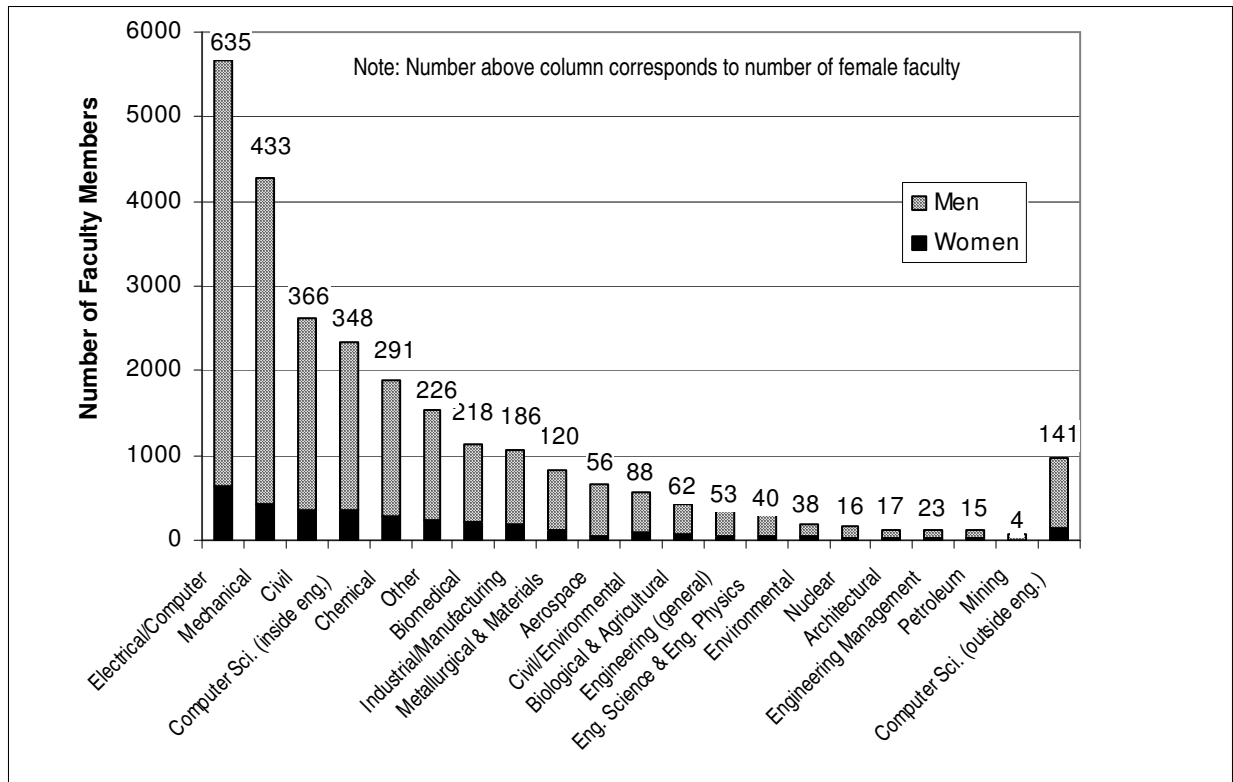
[Data cf. ASEE, 2006]

Figure 2. Percentage of female engineering faculty members by discipline
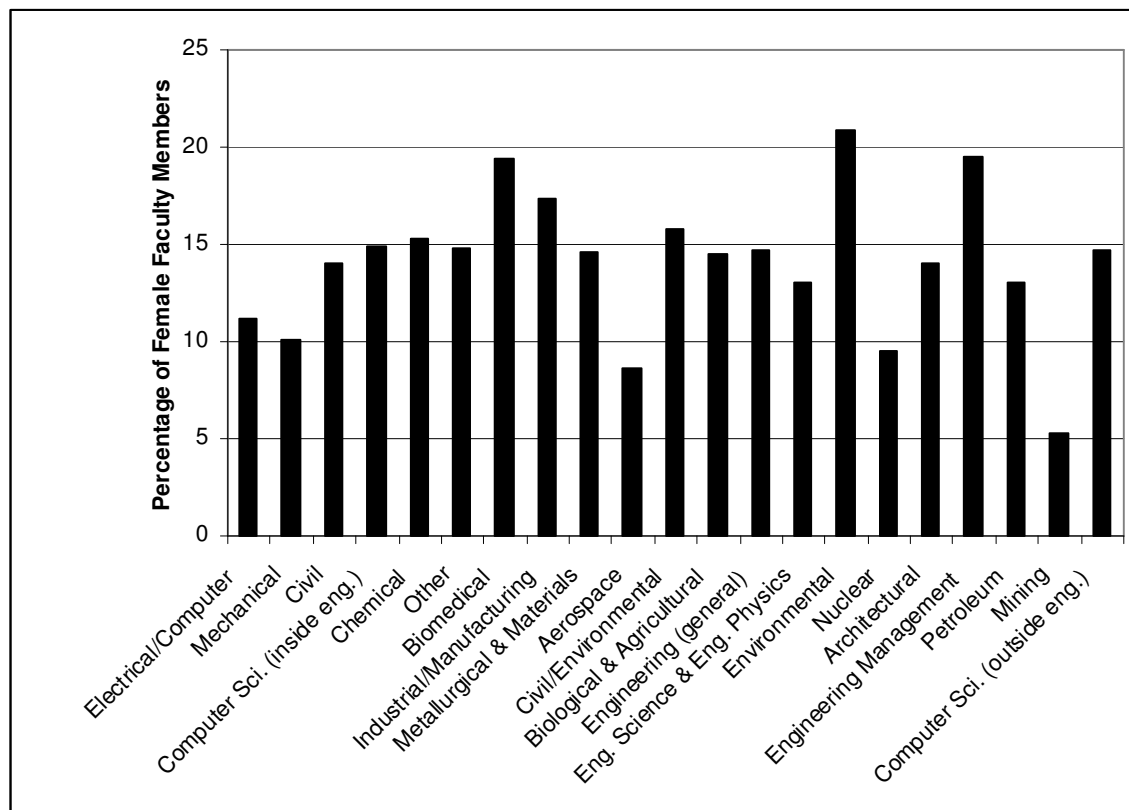
Unfortunately, data from the recent *Science and Engineering Indicators 2012* (NSB, 2012) show that the pipeline into the professoriate does not show significant increases in women completing doctoral degrees in mechanical engineering, ultimately resulting in a limited number of candidates available for faculty positions (Figure 3).

Figure 3. Number of doctoral degrees awarded in mechanical engineering by gender
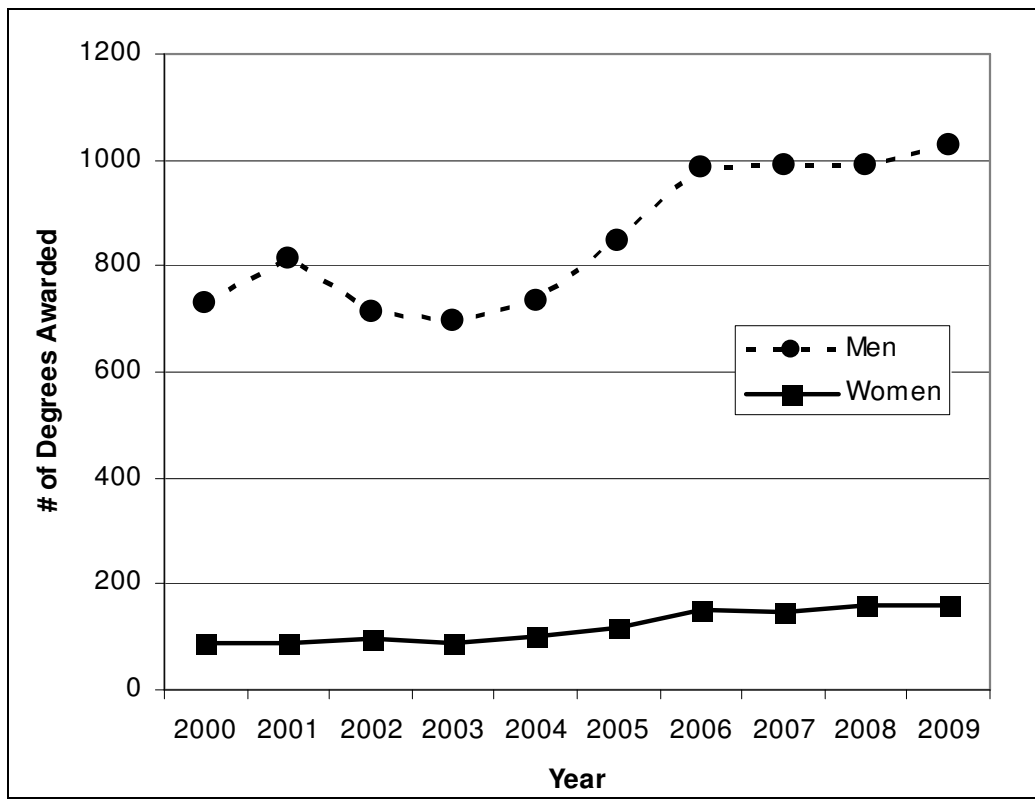
Current research has focused on the effect of institutional climate on female faculty members (Etkowitz, Kemelgor, & Uzzi, 2000; Nelson, 2005; Tindall, 2006) but limited work has been done specifically on the field of mechanical engineering. Ali (2007) analyzed the *National Study of Postsecondary Faculty* questionnaire to determine trends of female faculty members over an eleven-year period, but she did not break out specific fields of study in her work, and in fact, suggests that additional work is needed in the area of engineering. Without a more detailed understanding of the nature of the experiences of female mechanical engineering faculty members, and whether these experiences are similar to the entire population of female faculty members, it is difficult to determine whether traditional diversification strategies would be effective.

With these research issues in mind, I implemented a pilot study in winter 2007 to understand more about why there is an underrepresentation of women in mechanical engineering academia. The purpose of the pilot study was to investigate the factors that support or impede women's interest and persistence in mechanical engineering. More specifically, the following research questions were addressed: (a) What are the educational, societal, and institutional barriers and facilitators that influence women to pursue a doctoral degree in engineering and a subsequent faculty position? (b) How do these experiences compare with experiences of male engineering faculty members? (c) How do male and female professors compare regarding their perceptions of the influence of the departmental and institutional culture on the development of women engineering faculty?

The pilot study involved interviews with fifteen female and seventeen male mechanical engineering professors at eight universities from across the United States. The study involved a one-on-one interview with each faculty member with a goal of obtaining a brief history of his or her progression into mechanical engineering and consequent employment experiences as a faculty member.

The findings of the pilot study suggest that there is an overall lack of mentoring given to undergraduates, resulting in a limited number of individuals entering graduate school. Pilot study findings also indicate that female faculty members have a difficult time establishing research collaborations, likely because of the reported chilly climate in the mechanical engineering department. These findings suggest that more research is needed to determine the role of departmental climate with regard to female mechanical engineering faculty members' satisfaction, specifically in relation to the nature of work, collegiality, compensation, policies and practices, and tenure.

Purpose of the Study

The purpose of this sequential, mixed-methods study is to better understand how female mechanical engineering faculty members' career experiences in academia affect their satisfaction. This study builds upon the research from the pilot study by focusing on gaining a more complete understanding of faculty members' perceptions of departmental climate using two data sources: questionnaire data and in-depth interview data. In this study, the *Survey of Tenure-Track Faculty Job Satisfaction* (Collaborative on Academic Careers in Higher Education [COACHE], 2007) questionnaire data is used to measure the relationship between gender and tenure-status and a number of factors related to departmental climate (instructional responsibilities, workload, compensation, atmosphere of collegiality, clarity of expectations, and satisfaction). Differences between males and females and among faculty members of different academic ranks are determined by calculating chi square statistics for each item on the survey. At the same time, the departmental experiences that contribute to female mechanical engineering faculty members' satisfaction in academia are explored using survey responses and interviews with 28 male and female faculty members at ten academic institutions across the United States, some of whom participated in the pilot study. The participants ranged in ethnicity and academic rank, and the universities ranged in size and location. The interview participants completed the COACHE survey online prior to being interviewed. The interview questions served to add personal experiences to the quantitative analyses. Analysis of the interview data was driven and shaped by theory, specifically using the lens of Acker's theory of gendered organizations (Acker, 1990, 1992) to provide perspective on the meanings inherent. Using this theory, data were thematically coded, grouped by themes and then categorized and labeled. The data were collected over the course of seven months, beginning in July 2009. By using national survey

data in conjunction with faculty member interviews, I hope to generate findings that will help

mechanical engineering departments across the United States better understand ways to create a

positive climate to ensure the success of female faculty members. A description of the

importance and effectiveness of formal and informal policies and procedures that contribute to

the satisfaction of mechanical engineering faculty members is also included.

Research Questions

1. In what ways do departmental climates or cultures influence the satisfaction of

    mechanical engineering faculty members?

    a. Do mechanical engineering faculty members perceive departmental climate

        differently based on their rank?

    b. How do male and female mechanical engineering faculty members compare with

        regard to level of satisfaction with the nature of their work?

    c. How do perceptions of resource allocations compare for male and female

        mechanical engineering faculty members?

    d. How is job satisfaction related to perceptions of departmental policies/practices?

    e. How do male and female mechanical engineering faculty members compare with

        regard to their employment satisfaction in academia?

Significance of the Study

The research base on underrepresentation of women in science and engineering is vast

and more work is done every year. Research has shown differences in academic population by

gender. In a study done by the Committee on Women in Science and Engineering of the

National Research Council, researchers determined that although women professors are found

more often in research universities now than in 1973, the number of women in the engineering

workforce at Research I universities is only 6% (Long, 2001). Long's study addresses the differences in the careers of male and female scientists and engineers, but does not examine the specific factors that may have hindered or supported those females in their efforts to obtain a doctoral degree. The literature on the challenges women face while employed in academia is also rich. A number of studies address the careers of female faculty members, and many focus on the role of career satisfaction on retention (August & Waltman, 2004; Bronstein & Farnsworth, 1998). These two studies are wide reaching in that the participants are faculty members in all fields but only one research site is used. The current research base has not affected policy changes that allowed for a significant increase in the number of women entering mechanical engineering and ultimately becoming faculty members, so more research must be published to strive for this goal. The proposed study adds to the research base because it is discipline-specific, and the field of mechanical engineering has a much smaller proportion of women than many other STEM fields. This study will add to the knowledge-base about the specific experiences and needs of women faculty members in mechanical engineering as well as provide a basis for understanding how these experiences and perceptions differ from what their male colleagues report. The research base has few mixed methods studies and the current study includes a participant population which allows for numeric trends from the national survey data and detailed viewpoints from faculty members across the country. Gathering data from a wide range of universities and faculty members will allow for greater generalizability of findings in contrast to the current research-base which has focused more narrowly on single-university studies.

My personal experience with graduate study in mechanical engineering influenced the choice of research study. The motivation to attempt this research stemmed from a desire to

understand the strategies successful female mechanical engineering faculty members use that contribute to their satisfaction in their current academic position. Informing the literature with details about the career experiences of female mechanical engineering faculty members is a needed step if institutions and departments are going to change their practices.

Definition of Terms

Successful: In this research study, a female faculty member is considered successful because she has obtained a faculty member position in academia; success as a faculty member is contingent on continued employment in academia.

Mentor: In this research study, a mentor is any individual who provides advice or guidance; this could be in regards to education, career, or personal issues.

Challenge: In this research study, a challenge is any obstacle or barrier that must be dealt with or overcome.

Nature of work: In this research study, the nature of work denotes the day-to-day activities of a faculty member, including: numbers of hours worked, courses taught, and time for research.

Institutional policies/practices: In this research study, policies and practices involve a number of factors: faculty mentoring programs, informal mentoring, formal performance reviews, assistance in obtaining external funding, assistance for improving teaching, travel funds, and research/personal leave. (cf. COACHE, 2007)

Resource allocation: In this research study, resource allocation involves a number of factors: amount of office space, amount of research space, number of graduate and teaching assistants, and quality of facilities.

Satisfaction: In this research study, satisfaction is determined on a number of factors related to

      professional and personal/family life. This includes satisfaction with: support for

      personal/family life events, compensation, climate, culture and collegiality. (cf.

      COACHE, 2007)

<div align="center">Overview of Chapters</div>

      This section gives an overview of the content of the dissertation. Chapter II includes a summary of previous research related to the climate in academia and a theoretical foundation related to gendered organizations. Chapter III presents the methodology used in the study, including the research design, the data collection and analysis procedures, and a summary of the demographic characteristics of the sample. Chapters IV and V include the quantitative and qualitative results related to the research questions. Chapter VI presents a discussion of the findings and a comparison of the findings to the literature. Finally, recommendations are presented for mechanical engineering departments, mechanical engineering faculty members, and future research.

CHAPTER 2: REVIEW OF THE LITERATURE

Introduction

Why would a woman choose to major in a field that provides a limited number of same-sex role models? What factors cause her to stay in the field and progress through the pipeline to graduate school and beyond? Many researchers ponder these questions. There are at least three schools of thought as to the reasons why there are so few women in engineering academia. Some believe it is a pipeline issue, where the small number of women earning bachelors degrees in engineering causes a shortage further down the academic pipeline (Leslie, McClure & Oaxaca, 1998; NSB, 2008; NSF, 2007a; Plummer Cobb, 1984). Others argue that the climate within institutions and engineering departments strongly impedes the success of female faculty members and students (Etkowitz, Kemelgor & Uzzi, 2000; Gornick, 1983; Plummer Cobb, 1984; Saraga & Griffiths, 1981). Lastly, it is argued that mentoring plays a critical role in all stages of academia and the lack of female mentors or role models results in a smaller number of women entering graduate school (Brainard & Carlin, 2001; Carter & Kirkup, 1990; McIlwee & Robinson, 1992; Nelson, 2005; Wyer, 2003). Without women in visible leadership roles in engineering academia there is no incentive for young women to enter the field (McIlwee & Robinson, 1992; Sonnert & Holton, 1995). This research study focuses on the nature of faculty members' experiences in academia and how these experiences effect their satisfaction with their university, with their colleagues, and with employment as an academic.

The Engineering Pipeline

Contrary to popular belief, the United States Department of Education reported recently that male and female students enroll at similar rates in both high school pre-calculus courses (28.0 and 30.8 percent, respectively) and high school physics courses (34.8 and 30.8 percent,

respectively) (NCES, 2008). Leslie, McClure, and Oaxaca (1998), in their synthesis of national survey data, realized that in order to fully understand the underrepresentation of women and minorities in science and engineering, research must look at the years leading up to college. They explain this by referencing the similar attrition rates of men and women in post-secondary education, where the difference is only evident in the number of men and women who *enter* science and engineering fields. Hanson (1996) reiterates this when she states that "science experiences are not snapshot events that can be captured at one point in time" (p. 184) so research must be done that captures individuals' experiences over time. After analyzing bi-yearly data from a six-year study of high school sophomores, Maple and Stage (1991) argued for the implementation of early intervention programs designed to develop interest in mathematics and science related fields. Many researchers go even further by saying that interventions should begin during pre-adolescence since this is *before* negative attitudes toward mathematics and science have taken hold and continue through all grade levels (Chacon & Soto-Johnson, 2003; McIlwee & Robinson, 1992). Asera and Treisman (1995), in their study of minority student participation in summer institutes, relay the lack of information given to students about mathematics and science careers, as well as the overall lack of female role models in these careers. McIlwee and Robinson agree and suggest that if teachers, counselors, and parents were "…educated about opportunities for women in engineering, and about the actual nature of the work, they can play an important role in the recruitment process" (p. 179).

Educators play a significant role in advising students on career choices and they should use the opportunity to provide students with a clear understanding of *all* options available to them. Unfortunately there are limited discussions of career opportunities in 7-12 grade science and mathematics classrooms, and the small number of females in science and engineering careers

make them seem invisible. This lack of coverage in secondary schools is regrettable, since one of the content standards in the National Science Education Standards (National Research Council [NRC], 1996) details the importance of teaching about the nature of science, including the human dimensions of science and the scientific enterprise. A number of researchers have found positive implications to providing students with information about career opportunities. Chacon and Soto-Johnson (2003), in their study on the influence of mathematics camps on young women's educational decisions, suggest the importance of orienting students to potential careers, and recommend that these orientations involve working professionals who discuss specific attributes of their careers. In mathematics, a number of summer mathematics camps for high school women have been developed, and all of the camps have shown a positive outcome in student attitudes about mathematics (Chacon & Soto-Johnson, 2003; Kirwan, 2001). This trend has progressively been moving into the engineering realm, with schools such as Ryerson Polytechnic University (Toronto), Israel Institute of Technology, Washington State University, the University of Washington, Worcester Polytechnic Institute, University of North Carolina and many others implementing summer engineering camps for high school females. In all cases, the camps helped to increase young women's understanding of engineering as a field of study, and in some cases, the camps positively affect the number of participants who ultimately enroll in an engineering program (Gilbride, Kennedy, Waalen, & Zywno, 1999; Hazzan, Levy, & Tal, 2005; Hannan, Calkins, Crain, Davis, Gentili, Grimes, & Trevisan, 1997; Demetry & Nicoletti, 1997; Kuyath, Murphy, & Sharer, 2005; Bee, Puck, & Heimdahl, 2003). Some universities go so far as to partner with local public schools to aid them in incorporating engineering lessons into the 6-12 grade classroom using *Project Lead the Way* or other curriculum modules (Adelson & Blais, 1998; Kimmel & Rockland, 2002; McVearry, 2003). The Extraordinary Women Engineers

Project (Patel-Predd, 2005) is a similar project aimed at changing the perception of engineering among high school females. The project team began by surveying high school females to find out why they don't enter engineering; some of the recurring beliefs are no surprise: engineers don't have the potential to change society like lawyers, doctors, etc.; engineers have dull lives and are stuck in cubicles (i.e., Dilbert); engineering is not cool; and finally, many just do not understand what engineers do. These beliefs are prolonged because many teachers, counselors, and parents endorse the traditional idea that engineering is for men. Plummer Cobb (1984) explains the role parents take in fostering these beliefs because "…childhood sex-roles are established early, beginning literally in the crib…the female child learns at two, three, and four years of age certain sex-linked behavior, and that passivity and dependency are generally acceptable" (p. 78). Unfortunately, the sex-roles initially differentiated at home can be perpetuated throughout secondary school where students are "…subject to pressures to conform to societal expectations of sex-appropriate behavior and interests" (p. 79). There is hope, however, as Carter and Kirkup (1990) found that parents vary in their culture and expectations, "…sometimes complementing what took place in school, sometimes opposing it, sometimes offering the young women encouragement" (p. 36). They clearly suggest that society encourage parents to do more of the latter. Plummer Cobb suggests that parents are reminded of their role in shaping "the mind-body concept of the child" (p. 76), and warns parents against using "different social rewards" (p. 77) for female children.

        As far as entrance into the undergraduate engineering pipeline, the number of women still lags far behind the number of men. Regrettably, women entering college do not even intend to enroll in engineering, which means the educational pipeline to higher degrees and ultimately careers in higher education, is limited as well. In 2004, 26.3 percent of all incoming female

freshmen intended to major in science and engineering fields, but of these only 2.9 percent intended to major in engineering (NSF, 2007a). This small number of women intending to major in engineering is then further divided when students choose a discipline within engineering. The latest *Science and Engineering Indicators* report highlights this fact in reporting that while the percentage of females earning bachelors degrees in engineering is 20, this percentage is substantially lower for mechanical engineering, at 13.1 (NSB, 2008) [see Figure 4].

Figure 4. Percentage of bachelors degrees awarded to women by engineering field
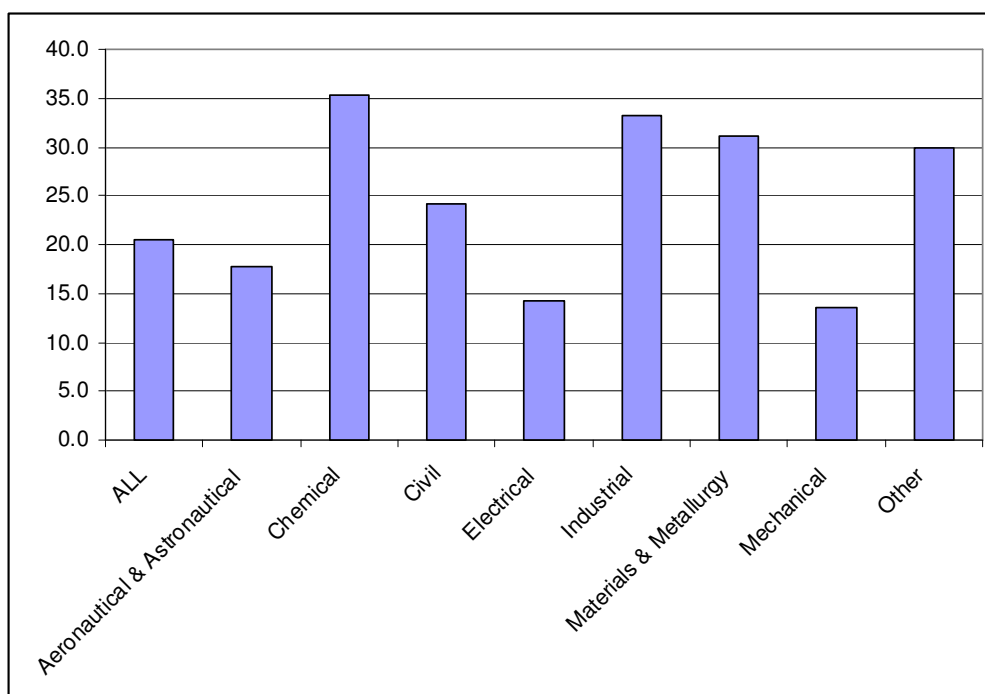
Looking at this figure, it is interesting to note that the two largest fields of engineering, electrical and mechanical, account for the low overall percentage of women obtaining bachelors degrees in engineering.

Another aspect of the engineering pipeline issue involves the attrition of students out of engineering programs. Seymour and Hewitt (1994) did an extensive study comparing students who persist in science and engineering coursework to students who drop out of college or switch

to another program. They found two distinct groups of students who transfer out of science and engineering programs; those who become bored or dissatisfied with the curriculum, and those who feel compelled to leave due to loss of self-confidence in a highly competitive academic environment. Gornick (1983) expands on this explanation of loss of self-confidence with her poignant descriptions of women in engineering academia who have "felt invisible and discounted, left out and whittled down" (p. 73). She says that the reason women leave engineering is not a result of one negative experience, rather "…it accumulates from more than one point of origin; is felt as an institutional assault, a psychological infliction, choice forced on one rather than choice freely made" (Gornick, 1983, p. 73). Farrell's (2002) more recent work shows a slight shift in reasoning, whereby female students' lack of interest in engineering is based primarily on the fact that they don't see the relevance of the subject material to real-life applications. This reasoning follows current K-12 science education reform efforts promoting selection of 7-12 grade science content to "meet the interests, knowledge, understanding, abilities, and experiences of students" (NRC, 1996, p. 3) thereby providing the students with content that is relevant and applicable.

Climate in Academia

A second line of thought concerning why so few women enter engineering academia concerns the climate within the academic environment. Initially the halls of engineering academia were almost completely filled with male professors and students. Over the past twenty years, female bachelors degree recipients in engineering have increased by six percent, but over the same number of years the increase in mechanical engineering bachelors degree recipients has been only three percent, hovering between 11 and 14 percent (NSF, 2007a). Research has shown that the climate within an institution or department can negatively affect female employees,

ultimately leading to low numbers of women in the institution (Etkowitz, Kemelgor & Uzzi, 2000; Gornick, 1983; Jaiswal, 1993; Nelson, 2005; Plummer Cobb, 1984; Trescott, 1984). The steady number of women completing bachelors degrees in engineering could be a signal that the climate within engineering departments has remained stagnant over the past twenty years as well.

It is interesting to note that numerous authors describe a "culture of engineering" that is evident in both academic institutions and private companies across the country (Hacker, 1981; Saraga & Griffiths, 1981; Tonso, 1996). Hacker developed her account of a culture of engineering after studying faculty members and students at an east coast engineering college. The culture she describes emphasizes a number of qualities: technology instead of personal relationships; abstract knowledge instead of humanistic knowledge; and male instead of female traits. It also highlights mathematics and mathematical ability, which are considered to be "masculine" (Hacker, 1981). The masculinity of engineering is further suggested by Saraga and Griffiths (1981) who say that if successful scientists hold personality traits which are stereotypically male, girls will not choose science because of a possible "personality incompatibility" (p. 85). Etkowitz, Kemelgor, and Uzzi (2000) in their discussion of the negative climate in academic science argue that "the organization of science, particularly at the department and university level, differentially *treats and disadvantages* women" (p. 155) suggesting that changes should be made at these levels to create a better environment. Based on this research, it could be assumed that the university is the birthplace of the "culture of engineering" since this is where students are initially indoctrinated in the field. In a telling description of the role of the university education in creating the culture of engineering, Tonso (1996) describes engineering education as, "…not simply training in a prescribed set of appropriate, academic courses, but is enculturation into a well-established system of practices,

meanings, and beliefs" (p. 218) and ultimately it provides the training for what to expect and how to act in the engineering workplace. She continues by suggesting that in order for the climate in academia to improve for women the context of the engineering classroom must be modified to allow for genuine communication in the classroom. Other researchers agree that communication is a key factor in drawing more women into the field of engineering. Students will not know about their options after completing their bachelors degree without good communication between faculty members and students. Plummer Cobb (1984) agrees and in turn promotes the "sensitization of male college science professors and college administrators to think about ways in which they can encourage women to major and progress in science" (p. 80). Students need encouragement from their professors and mentors to continue into graduate education, and this encouragement is likely easier to get from same-sex faculty members. Consequently, male professors, being the majority on campus, need to make a concerted effort to reach out to female students.

The culture of engineering does not just affect undergraduate students, but also female graduate students and faculty members as well. A smaller number of women than men progress on to graduate study, and they find more prejudice at this stage of their career. Sheila Widnall (1988), former AAAS President, and advocate for increasing the number of women in scientific careers, reported that female graduate students lack opportunities for mentorship, especially with well-respected faculty members, are expected to produce less, and are less likely to become research assistants. The chilly climate women experience as graduate students must certainly affect their career decisions. In particular, Nelson (2005) found that recent female PhD graduates in science and engineering "do not perceive the academic environment as desirable, so they choose not to apply for faculty positions" (p. 4). Similarly, van Anders (2004) observed

that women in all disciplines "self-select away from academia because of issues related to parenting and mobility" (p. 518), and "that more men than women think that academia is compatible with having children" (p. 519). Trower and Chait (2002) agree, as they found that "despite 30 years of affirmative action, and contrary to public perceptions, the American faculty [member] profile, especially at preeminent universities, remains largely white and largely male" (p. 33). They continue their argument by saying that women *are* in the pipeline in engineering academia but, "the pipeline empties into territory women and faculty [members] of color too often experience as uninviting, unaccommodating, and unappealing" (p. 34). The obstacle Trower and Chait describe is the previously mentioned culture in engineering, whereby graduate students are socialized by their mentors to conform to the standards, some of which are subtle, such as stereotypes based on gender or race, or value corresponding to types of work (research, teaching, service) or research (theoretical, experimental, qualitative, quantitative). This explains why the climate in engineering does not get better with time; it is perpetuated through the generations of graduate students who experience the prejudice (real or implied) expressed by their graduate mentors.

Understanding the Role of the Institution/Department

Other authors reiterate the role of the institution, especially in an interdisciplinary field like engineering. In particular, Fox (1996) relays the importance of organizational setting to the "status and performance of women in academic science and engineering" because these fields "involve the cooperation of persons and groups and require human and material resources" (p. 280-281). She suggests that in engineering academia the climate must be such that women and minorities feel welcomed and not shunned, both within their departments, their institutions, and their fields of study. More recently, Etkowitz, Kemelgor, and Uzzi (2000) surveyed faculty

members in six hard sciences and found that many female faculty members are neglected by their colleagues. This neglect is unanticipated because though they may have been the lone woman student during their graduate career, the atmosphere in graduate school was far more collegial. These researchers believe that neglect can "hurt the development of a sense of professional identity", and quote a female junior faculty member who said, "…it gets lonely. A lot lonelier as you move up because you have no peers to talk to" (p. 138). The result is that women do not have full membership in their scientific community, they feel alienated, become guarded, and feel a need "to prove oneself" (p. 139). Overall, female faculty members surveyed reported lower levels in the quality of departmental relationships and the number of interdepartmental ties. In their analysis, Etkowitz and her colleagues suggest that social capital plays a major role in preventing "women's full participation in scientific careers" (p. 177). Social capital is defined as the "web of contacts and relationships that provide information, validation, and encouragement" and, in particular, "the productive resources a person gains access to through contacts…or creates with [contacts]…which decrease in value if the relationship ends" (p. 117). This definition implies that a person's social capital is dynamic and can change depending on the type of situation he or she is working in. Specifically, a person's social capital can be greatly affected by the policies of an institution as a whole. Sonnert and Holton (1995) are in agreement, as they believe the career phase is where "women scientists most clearly experience structural obstacles, usually in the form of discrimination in hiring, promotion, tenure awards, or research funding" (p. 10). Hence, these obstacles are a result of department chairs, tenure committees, and colleagues who are biased against women. Nelson (2005) believes that the lack of female faculty members in academia "sends a message to men that women do not belong in these non-traditional environments and that it is acceptable for them

to be marginalized, denied tenure, and given unequal resources" (p. 2). This message perpetuates the masculine image of engineering, and limits the potential of female students and faculty members.

Paying Attention to the Lack of Female Faculty Members in Engineering

A number of national reports have recently brought attention to the shockingly low numbers of senior female faculty members in engineering fields. Notably, the American Association of University Women (AAUW) in their report *Tenure Denied* found that "women remain underrepresented at the highest echelons of higher education" (AAUW, 2004, p. 1). They continue by reporting that though almost forty percent of full-time faculty members are women, only one-third of associate professors and one-fifth of full professors are women. These numbers signify that in many fields the number of tenured female faculty members is low, and in fact this trend is even more severe in the field of engineering. Figure 2 illustrates the stark contrast between the percentages of female faculty members in engineering as compared to other fields using data from the National Center for Educational Statistics (NCES, 2008). The percentage of tenured or tenure-track female faculty members in engineering (11.3) is far less than that of men, with the two largest engineering fields, electrical and mechanical, even further behind in percentage of female faculty members (9.8 and 8.5 percent, respectively) (ASEE, 2006). In fact, Nelson (2005) found that in the four largest fields of engineering, female faculty members are most highly represented at the rank of assistant professor, whereas men are mostly full professors (Nelson, 2005). This was found to be true in a study done more than ten years earlier, where McIlwee and Robinson (1992) found that as "in other male-dominated professions, [women in engineering] find themselves segregated into lower status positions, with less chance of moving" (p. 5) through the ranks into senior level positions. The low female faculty member

numbers in engineering are detrimental to the recruitment and retention of female engineering students because "unless women are widely and visibly succeeding in the field, there will be little incentive for others to follow their lead…The woman in engineering will remain a token, always standing out and often falling behind, rather than becoming a routine and well-integrated part of the work group" (McIlwee & Robinson, 1992, p. 6). A token female faculty member does not display to female students that a career in academia is a possibility. This is especially true if students believe that female faculty members must make extraordinary sacrifices to be successful and gain tenure. Students should feel like they can choose to major in any field they desire, but this is not always the case for women. Interestingly, Trower and Chait (2002) found that "the most accurate predictor of subsequent success for female undergraduates is the percentage of women faculty members at their college" (p. 33). They continue the argument for more female faculty members with their assertion that women who attend single-sex colleges "earn two to three times the number of advanced degrees" (p. 33) than women attending other institutions.

Figure 5. Percentage of female faculty members by general field
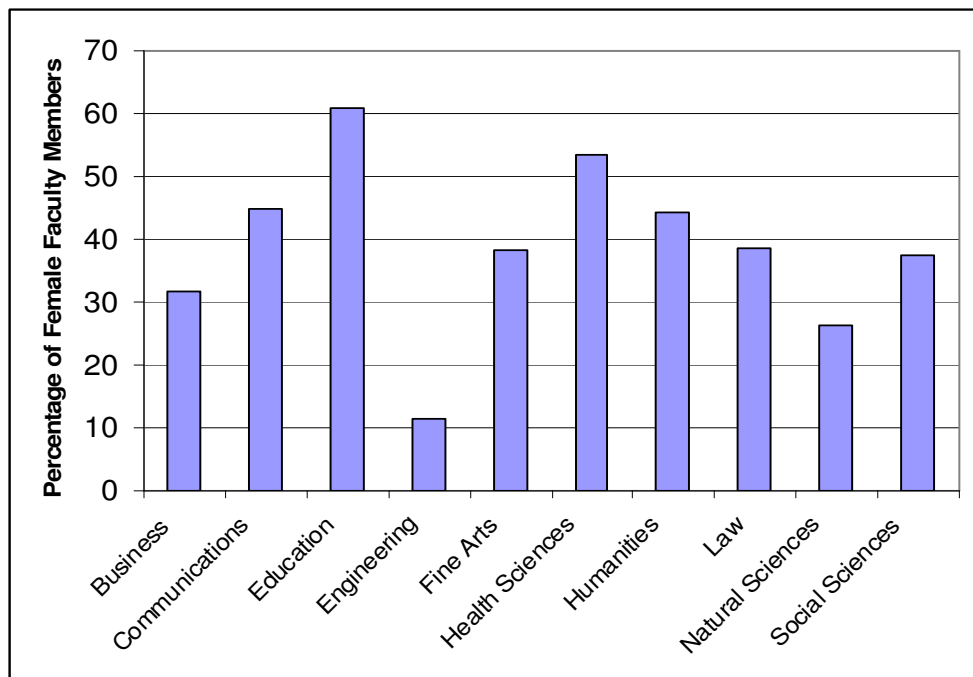
In a drastic move to express their dismay at the low numbers of female science faculty members, in 1994, fifteen of the sixteen tenured women science faculty members at the Massachusetts Institute of Technology (MIT) sent a proposal to their Dean about their "serious concerns about the small number of women professors" (MIT, 1999, p. 6). For the previous decade, the percentage of female faculty members in the School of Science had remained stagnant at around eight percent. The results of the study were similar to other studies, where research showed the percentage of women in science decreases at each stage of the academic pipeline, and that because of this "there was no indication there would be any change in the foreseeable future" (p. 8) of the number of female faculty members. Nelson (2005) had similar findings, where she reported very small increases in female faculty member representation in science and engineering over the past twenty years.

Obstacles to Success in Academia

The question remains, how can the environment in academia be changed to support female graduate students and faculty members? Etkowitz, Kemelgor, and Uzzi (2000) argue strongly that "departmental reform is the means to overcome the exclusion of accomplished women from full membership in the Republic of Science" (p. 179). They describe two types of academic departments, instrumental, where the "numbers of American women graduate students and/or degrees conferred were lowest", and relational, "where positive cultural shifts are occurring" (p. 179). Instrumental departments tended to cause women to feel isolated, have low morale, and be biased because of "generational attitudes" (p. 180), not specifically gender. In contrast, relational departments have an atmosphere that "provides the safety to take the risks necessary for innovative work and the collaborations necessary for networking" (p. 181). Women in relational departments do not report feeling isolated or having low morale, and in fact, encourage other women to take positions in departments that share these attributes. In a study of the School of Science at MIT (1999), some departments were found to have unequal resources and rewards for male and female faculty members, including space allocations, teaching assignments, awards, and committee work. Using interview data, it was found that a common theme mentioned by many senior women faculty members were their feelings of invisibility, and being "excluded from…their departments and from positions of any real power" (p. 8). Interestingly, this feeling was not shared by the junior women faculty members, in fact, the opposite was expressed. The junior women frequently mentioned a concern for managing family and work responsibilities. An emergent theme from this study involved the realization that the senior women had begun their careers "believing that gender discrimination was 'solved' in the previous generation" (p. 9), and only after working in academia for years had they recognized

that there were still forms of discrimination occurring (MIT 1999). It could be assumed that the junior women faculty members hold this same belief and just have not been in academia long enough to know that discrimination, in one form or another, is still an issue.

Discrimination does not only occur at the departmental level, but can also be present at the institutional level. To better define the types of institutional discrimination that women may face, Rajendra Jaiswal (1993) in her study on the underrepresentation of Indian women in science and engineering differentiated between two types of institutional discrimination, overt and covert. She describes overt as deliberate and intended to prevent women from accepting a job or progressing in a job, and covert as underlying the decisions made within an institution. Covert discrimination could include assigning less important tasks to women or not recognizing women for exceptional performance. Though this study was not focused on women in academia, it is possible to say that these types of discrimination are visible, if not pronounced, in the academic environment as well especially considering Jaiswal's conclusion that most discrimination is found in the "latent and covert forms" (Jaiswal, 1993, p. 129). The difficulty in addressing the covert discrimination in science and engineering lies in the inherent notion that scientists believe in their own objectivity and "make decisions on the basis of a shared social reality (Gornick, 1983, p. 71)" which makes it hard for them to see that they are acting in a discriminatory manner. As an example of this discrimination, a large number of the 250 respondents to Robinson and Reilly's (1993) survey of female engineering graduates reported experiencing sexual harassment (about 18%) or being discouraged by negative attitudes from faculty members (25%) while they were completing their engineering degrees. Similarly, Wasburn (2003), in her study of female faculty members at a Research I University, found that almost half (46%) of the 166 female faculty members surveyed thought the campus climate was

oppressive for women. Reform initiated from the highest echelons in academia may be the only way to influence scientists and make the environment for women and minorities more congenial. McIlwee and Robinson (1992) deem that without more females in the field, "engineering will continue to be one of those 'men's jobs,' entered only by the most hardy—or foolhardy—of women" and that for "constructive social change" (p. 6) to occur there must first be a greater awareness of women's experiences in the field.

For women who succeed in obtaining an academic appointment in science or engineering, there are still obstacles to success based on social norms. Sonnert (1999) summarizes two of the most prevalent schools of thought on why women scientists are less likely to have successful careers than men in his description of the deficit and difference models. He explains that in the deficit model structural obstacles which exist within society cause women to receive fewer opportunities in their careers; whereas in the difference model men and women are innately different in their goals. In both of these categories of thought societal expectations play a major role in whether a woman is successful or not. Plummer Cobb (1984) describes a number of measures that would show a positive change for women in scientific fields, including:

1. the proportion of women in the field is no longer an issue;

2. parents no longer think their female child's interest in math is unusual or odd;

3. salaries of women in science and technology are equal to men;

4. the number of women working in science and academia is equal to the number of men;

5. women are in management positions in scientific companies (p. 75).

A number of educational institutions are tackling these measures, specifically trying to increase the number of women in science and engineering. Stewart, LaVaque-Manty, and Malley (2004)

report that at the University of Michigan, a new recruitment method focused on "peer education conducted by senior science and engineering faculty members" (p. 363) was successful because the science faculty members were "more receptive to hearing about" ways to increase female hiring from "colleagues whom they already respect both as researchers and individuals" (p. 363). In particular, the peer education in the College of Engineering (along with other interventions) led to an increase in the percentage of women hired in the college from 8.3 percent in the two-year academic period of 2000-2002, to 29.2 percent in the 2002-2003 academic year. As another example, researchers at the University of Wisconsin-Madison developed active learning workshops for faculty member search committee chairs and members to "provide information, advice, and techniques that will help them…diversify their applicant pools, their interview candidates, the offers they make, and ultimately the new faculty [members] they hire" (WISELI, 2002). Increases in women in minority faculty member hires as a result of the workshops have not yet been reported. The National Science Foundation is funding a growing number of institutions with their ADVANCE grants, aimed at increasing the participation and advancement of women in academic science and engineering, so more work in this area is imminent (NSF, 2007b).

The Role of a Mentor

When considering a career in science or engineering, many women seek advice from trusted family and friends to help make a decision. Role models and/or mentors in academia are often sought out, but only sometimes found, by students who are looking for career and academic advice. Nelson (2005) in her report on the status of underrepresented groups in the top 50 engineering schools, suggests that the lack of female mentors and role models causes a significant amount of the female student attrition in engineering. Saraga and Griffiths (1981)

report that fewer women enter the physical sciences because they see it as mostly relevant to industrial and military applications. Since military and industrial workers tend to be men, it is "less likely (for women) to enter the physical than the biological sciences" (Saraga & Griffiths, p. 85). There is no question that both male and female faculty members are resources to young women who are pursuing degrees in engineering, but women must be "widely and visibly succeeding in the field" (McIlwee & Robinson, 1992, p. 6) so that others believe it is possible. Brainard and Carlin (2001) report that in their six-year longitudinal study of undergraduate women in science and engineering, one of the primary factors that helps keep freshman women in science and engineering programs is the positive influence of faculty members. As the women progress through sophomore, junior, and senior year, they convey the importance of the positive influence of an advisor or mentor as a reason for staying in the program of study. Wyer (2003), in her study of 285 science and engineering majors found that students, both male and female, who held positive images of scientists and engineers were more likely to persist in completing their degree. Similarly, Seymour and Hewitt (1997), in their study on the attrition of undergraduates, found that women undergraduates in science, mathematics, and engineering are highly influenced by a significant other (family, high school teachers, other adults) in choosing their major and completing (or not) their degree in this major.

Many women have role models they aspire to be like, and women pursuing degrees in engineering are no exception. Carter and Kirkup (1990) highlight the importance of having women engineers as role models because it "helps to encourage other women into the field…see what can be achieved by women, and gain in self-confidence and awareness of their own potential" (p. 164). They continue with descriptions of a number of ways women act as role models, such as speaking to high school girls about careers and having lunch with

undergraduates to discuss graduate school, both of which are not too time consuming and have a positive effect on most of the students involved. The use of role models or mentors continues throughout the academic career, including during job searches and employment, and can include peers, relatives, professors, and deans (Trescott, 1984). Many women keep in touch with friends from their graduate school careers for "emotional support and confidantes" (Carter & Kirkup, p. 150) because they find that it is hard to make new female friends in their new jobs. Women engineers in industry have expressed the same need for role models, because without women in high level positions they see "evidence of the 'glass ceiling' women (engineers) face" (Catalyst, 1992, p. 21). Brown, Van Ummeren, and Hill (2002) in their report *Breaking the barriers: A guidebook of strategies,* identified lack of mentoring as one of the four factors that enhance or impede career mobility for women in academia. The report highlights a number of issues and questions that institutions need to consider while auditing their faculty member mentoring programs and making changes as appropriate.

Once a woman becomes a university faculty member, she may find that she has many struggles associated with mentoring students. It is assumed that female engineers will be role models and resources for young women, but as for the best ways to support young women, there is no clear consensus (Catalyst, 1992; Carter & Kirkup, 1990). In their study on female faculty members, Etkowitz et al. (2000) found that female faculty members feel a variety of tensions related to advising female students such as: how effective they will be; what the best way to mentor is; how candid they should be about their own difficulties in the field; and, how much time they can devote to women's issues. These researchers describe two styles of mentoring that faculty members use with students; instrumental and relational, which help depict the differences between how men and women tend to go about mentoring. The instrumental style is analogous

to the traditional male mentoring model, where intense competition and an exclusive focus on science are rewarded. In this mentoring style, which modeled what many older female science faculty members experienced in their own schooling, "child-bearing and child-rearing during the early stages of a scientific career were declared non-issues" (Etkowitz et al., p. 153). Female faculty members who use this style of mentoring have found it difficult to mentor the young women currently entering the field because these women "wish them to engage with them on a personal as well as a scientific level and, most importantly, to advise them about how to combine the roles of science and family" (Etkowitz et al., p. 153). In stark contrast, the relational style of mentoring, where collaborative experiences and effective interpersonal relationships are encouraged, is favored by younger female faculty members. This mentoring is more individualistic, focused on the differing needs and strengths of students, and these faculty members tend to "empathize with their female graduate students around issues of pregnancy and child-rearing" (Etkowitz et al., p. 154). A host of research in the mid-1980's showed the negative effect of the instrumental mentoring style on women, including lower expectations for females (Kistiakowsky, 1980; Widnall, 1988), difficulty identifying personally with a mentor (Widnall, 1988), and a reluctance to criticize female students, leading to less feedback on their work (Dresselhaus, 1986). This does not assume that all women students prefer the relational style of mentoring, but it is clear that a mentor who focuses on individual student strengths would be a better fit for the current cohorts of women students. Cuny and Aspray (2001) have a number of recommendations for faculty members to help increase the number of women in computer science and engineering programs such as: informing undergraduates about the opportunities and rewards of a research career, exposing them to computing research, giving individual encouragement to women undergraduates, actively countering negative stereotypes

and misperceptions of computer science and engineering, and providing female role models for undergraduates. All of these recommendations are easy for faculty members in all disciplines to do in everyday communication with undergraduates, assuming they understand the "disproportionately large impact" (Cuny & Aspray, p. 7) these positive interactions can have on women undergraduates.

Theoretical Perspectives

Multiple theoretical perspectives could be used to study experiences in academia and how experiences effect satisfaction. Bauer and colleagues (2007) defined an organizational socialization framework in terms of newcomers to organizations and how they find social acceptance with their peers. In particular, they describe how work related outcomes such as job satisfaction and intentions to remain are directly related to social acceptance by peers. Blackburn and Bentley (1993) posited a person-environment fit theory as a lens to study how personal and environmental variables moderate the effects of stressors on faculty member research productivity. They argued that a lack of fit between personal characteristics and the workplace environment cause stress which can decrease research productivity. In terms of organizational management, some researchers have furthered structural theories which describe discrimination as systemic whereby organizational policies and practices create a veiled system of discrimination (Morrison & Von Glinow, 1990). Though not based in organizational management specifically, the theory of gendered organizations, which posits that organizations are inherently gendered (Acker, 1990, 1992), was chosen as a frame for the current study. After reviewing the previously mentioned theoretical perspectives, I felt this was a logical theory to guide and ground the analysis of the interview data. Acker refers to the work by West and Zimmerman (1987) who provided a distinction between sex and gender, and described a new

interpretation of the use of the word gendered as an adjective. These researchers attributed sex

to biology and gender as "the product of social doings" (p. 129). They rationalized this by

suggesting that gender is the product of interaction and is displayed through interactions and

noted,

> Virtually any activity can be assessed as to its womanly or manly nature. And note, to
>
> "do" gender is not always to live up to normative conceptions of femininity or
>
> masculinity; it is to engage in behavior *at the risk of gender assessment*. While it is
>
> individuals who do gender…[it] is a feature of social relationships…If this be the case,
>
> can we ever *not* do gender? Insofar as a society is partitioned by 'essential' differences
>
> between women and men and placement in a sex category is both relevant and enforced,
>
> doing gender is unavoidable. (p. 136-37)

The premise for Acker's theory relies on this rationalization and she furthers it by stating that

"gender is a process, not a characteristic of persons, although of course the assignment of

persons to gender categories is a central aspect of the process" (1992, p. 567). Acker's theory is

used in the current study as a lens to look at the culture in a mechanical engineering department

and ultimately the experiences that affect faculty members' satisfaction. Alvesson and Due

Billing's (1997) work on gender and organizational culture suggests a coherent summary of what

is meant by culture:

1. what is shared by a group and departs from highly individualized ideas and
   circumstances;

2. the ideational level, that is what is on people's minds, their ideas and beliefs rather
   than how they behave or something else tangible; and,

3. the non-rational aspects, the value-laden, partly non-conscious dimensions of social

    life, including emotional aspects (p. 104).

They go on to suggest that culture is "not measurable" (p. 104), and that an analysis of culture

requires a synthesis of behaviors, interactions, and images is required to interpret the culture of

an organization.

Many researchers have used the theory of gendered organizations as a frame for their

research. Some have used it to analyze organizational policies that are believed to be gender

neutral to assess the levels of gendered interactions (Britton, 1997; Martin, 2003), while others

have used it to explore the policies and processes in organizations that appear to be uninviting to

women (or men, see: Sallee, 2012) (Bird, 2011; Kantola, 2008). Britton (2000) suggests a need

for using gendered organizational theory as a way to "identify and understand the factors that

give rise not to ungendered organizations, but to *less oppressively gendered*" (p. 430)

organizations so that the literature can reflect a range of examples of non-traditional (i.e.,

oppressively gendered) organizations.

<div align="center">Summary</div>

In summary, there are a wide variety of issues that face women entering the engineering

field. The literature addressing the underrepresentation of women in engineering is broad and

involves progressing through the lives of women and detailing issues that are present at each life

stage. In the pre-college years, researchers relay the importance of early intervention programs

which can provide students with the knowledge and ability to pursue careers in engineering.

These programs can take many forms: educating parents, teachers, guidance counselors and

students about engineering careers (Asera & Treisman, 1995; McIlwee & Robinson, 1992);

implementing summer engineering camps (Gilbride, et al., 1999; Hazzan, Levy, & Tal, 2005;

Hannan, et al., 1997; Demetry & Nicoletti, 1997; Kuyath, Murphy, & Sharer, 2005; Bee, Puck, & Heimdahl, 2003); or, incorporating engineering lessons into the 6-12 grade curriculums (Adelson & Blais, 1998; ; Kimmel & Rockland, 2002; McVearry, 2003). Many researchers argue strongly that stereotypical sex-roles championed by family or educators are still a prominent reason why female students do not consider engineering for a career (Carter & Kirkup, 1990; Plummer Cobb, 1984).

The small number of female faculty members in engineering also contributes to the shortage of women entering the field. The number of female faculty members has increased only slightly, and females are still most highly represented in junior faculty member positions (AAUW, 2004; MIT, 1999; Nelson, 2005). Many researchers discuss the difficulties society has imposed on females who have been successful in engineering, including experiences with sexual harassment and prejudice (Robinson & Reilly, 1993; Sonnert, 1999; Trescott, 1984). Fortunately, a number of institutions are making changes to recruitment and hiring practices in order to increase the number of women in science and engineering (Stewart, LaVaque-Manty, & Malley, 2004; WISELI, 2002).

A wealth of literature shows that the climate within an institution or department can negatively affect female employees, ultimately leading to low numbers of women in the institution (Etkowitz, Kemelgor & Uzzi, 2000; Gornick, 1983; Jaiswal, 1993; Nelson, 2005; Plummer Cobb, 1984; Trescott, 1984). In particular, researchers detail the masculine culture associated with engineering and how this disadvantages women from rising through the ranks, or even entering the ranks (Etkowitz, Kemelgor & Uzzi, 2000; Hacker, 1981; Saraga & Griffiths, 1981; Trower & Chait, 2002). A number of authors suggest that departmental reform is the key

to changing the chilly climate toward women in engineering (Etkowitz, Kemelgor & Uzzi, 2000; MIT, 1999).

Many authors relay the importance of visible female mentors and role models to increasing the number of female engineering students and graduates (Brainard & Carlin, 2001; McIlwee & Robinson, 1992; Nelson 2005). The use of role models or mentors for job searching or emotional support continues past the undergraduate career and on to professoriate and can include peers, relatives, professors, and deans (Carter & Kirkup, 1990; Trescott, 1984). In fact, lack of mentoring can impede career mobility for women in academia (Brown, Van Ummeren, & Hill, 2002). As far as serving as a mentor, female faculty members find that there are many struggles associated with mentoring students. Differing styles of mentoring can be more effective than others, and faculty members strive to find the style that works best for their students and themselves (Etkowitz, Kemelgor & Uzzi, 2000).

A framework for studying the role of culture and climate in a mechanical engineering department was presented. Joan Acker's (1990, 1992) theory of gendered organizations suggests that organizations are inherently gendered. Doing gender, a fundamental aspect of Acker's theory, is described by West and Zimmerman (1987) as engaging in behavior that can be assessed as womanly or manly in nature. Analysis of culture, as suggested by Alvesson and Due Billings (1997) involves an interpretation of the behaviors, interactions, and images present in an organization. Understanding the reasons for the underrepresentation of women in engineering is an important first step towards increasing the number of women in engineering. The future of our engineering and technology workforce depends on the education of more engineers, and women are a resource that has up until now been largely untapped.

CHAPTER III: METHODOLOGY

Theoretical Framework

The framework for this study is enhanced by a number of theories. Creswell (2003) suggests qualitative research theories are varied in usage, but two ways they can be used related to the current study are to explain behavior and attitudes or to guide research by way of a theoretical perspective or lens. The theory that guides the explanation of behaviors and attitudes involves organizational theory, specifically organizational culture. Organizational theory involves the study of organizations as a means to understand how an organization functions as a system (Berger & Milem, 2000). Baird (1988) suggested that organizational theory as a framework has been underutilized for understanding the role of the university environment on students. Organizational theory is the chosen framework because the ultimate goal of the research is to effect changes in academic organizational practices. Organizational culture is defined as the patterns of organizational behavior that have been institutionalized (Peterson & Spencer, 1990). Peterson and Spencer (1990) offer three principal features of organizational culture: an emphasis on the unique character of the organization; an enduring quality because of the culture's deeply embedded nature; and resistance to change that only happens through intensive, extended efforts. In order to fully understand the experiences of female faculty members in mechanical engineering, one must take into consideration how the culture of mechanical engineering departments affects these experiences. Astin and Scherrei (1980) note that organizational behavior is the means for colleges and universities to serve in a manner that promotes the development of students. In this sense, constructive organizational behavior of a university, and specifically of an academic department, could enable more students to continue on to graduate school and academic careers.

Similar to the organizational theory described above, another framework that gives perspective to the current research is gendered organizational theory. Acker's (1990) theory of gendered organizations assumes that all organizations are gendered, not gender neutral, an assumption that was previously taken for granted in organizational studies. She explains that to say an organization "is gendered means that advantage and disadvantage, exploitation and control, action and emotion, meaning and identity, are patterned through and in terms of a distinction between male and female, masculine and feminine" (p. 146). Acker goes on to describe five processes where gendering is likely to occur: the creation of divisions along gender lines; the construction of images that reinforce or oppose the divisions; the social interactions between individuals; the construction of gendered identities; and the creation and conceptualization of the social structure. The current research utilizes the first four dimensions of gendering and eliminates the fifth dimension, assuming that the social structure of a mechanical engineering department within a university is already well-defined and involves delving into the organizational logic of the university; a task beyond the boundaries of this research. The first dimension of gender hierarchy in Acker's theory involves the construction of divisions within an organization. These can be divisions of labor, allowed behavior, locations in physical space, or power. Important aspects of these divisions are: they are documented; they are often obvious to casual observers; and men are almost always in high positions (Acker, p. 146). The next dimension of gender hierarchy involves the construction of symbols or images that explain, express, reinforce, or sometimes oppose the previously mentioned divisions. These can be in the form of ideology, dress, language, popular culture, or media (e.g., the white-haired man in a lab coat). The third organizational process that promotes gendered hierarchy involves interactions. These interactions can be between women and women, women and men, or men

and men, and include all "patterns that enact dominance and submission" (Acker, p. 147).

Examples of these patterns include gender differences in amount of talking, interruptions, and

taking turns. The final dimension involves the production of an individual's identity, which may

be based on the existence and awareness of the other aspects of gender mentioned previously.

Taken together, these dimensions can help explain how the structure of the mechanical

engineering department affects the success of female faculty members. Benschop and Brouns

(2003) encourage this type of research as they believe that "the integration and mainstreaming of

gender issues within the academy will serve as a strong impetus to the necessary modernization

of the universities" (p. 209).

<div align="center">The Type of Research Design</div>

The mixed-methods research strategy used in the design of this study is a sequential,

explanatory strategy consisting of two distinct phases, quantitative followed by qualitative, as

shown in Figure 6 (Creswell & Plano Clark, 2007).

Figure 6. Sequential explanatory design (Creswell, 2003)
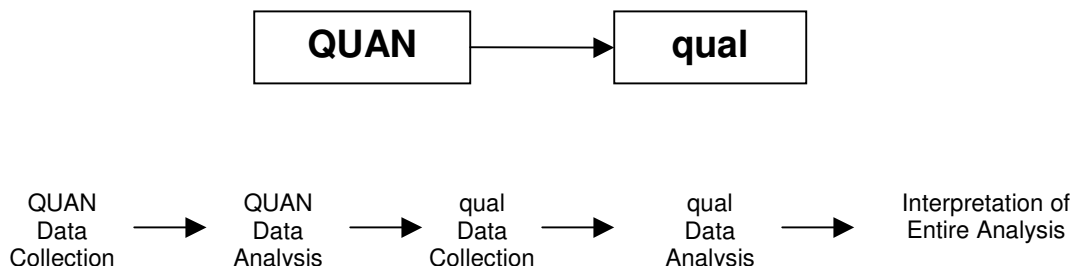
The sequential, explanatory strategy involves first collecting and analyzing quantitative data,

then moving onto the collection and analysis of the qualitative data as a means to help explain or

elaborate on the qualitative results obtained in the first phase. This strategy allows the researcher

to use qualitative results to build on and refine the quantitative analysis. The result is a more

thorough understanding of the research problems, leading to conclusions and implications that are driven by multiple forms of data and are more realistic and useful for the population.

Assumptions and Rationale for a Mixed Methods Design

A mixed methods research design combines elements of quantitative and qualitative inquiry in order to minimize the limitations that are inherent in each of these types of inquiry. Mixed methods research involves collecting and analyzing both qualitative and quantitative data. These data are merged, connected, or embedded in the analysis to provide "a more complete picture of the problem" than either of the types of data would provide on their own (Creswell & Plano Clark, 2007). Mixed methods research is useful because it allows researchers to tap into a variety of data collection techniques allowing for a thorough analysis of the research questions. Creswell and Plano Clark (2007) state that using a mixed methods design is preferred if quantitative data can enhance a qualitative design, or vice versa. In the current study, broad numeric trends in engineering and specifically in mechanical engineering provide generalizability and hard data for policy makers. Interview data provide explicit knowledge about the culture in mechanical engineering departments and experiences of mechanical engineering professors. The interview data detail the experiences of mechanical engineering faculty members as they progress through their academic career. The survey data provides a comparison about faculty satisfaction and workload, and can be analyzed by specific field or for engineering faculty as a whole to determine whether the interviewees' experiences are widespread or limited.

Types of Data

This research study involves collecting both quantitative and qualitative data to inform the researcher about the proposed research questions. The following sections describe the two

types of data that are collected using a questionnaire and an interview protocol and the

procedures for collecting each type of data.

Questionnaire Data

The bulk of the survey data is preexisting and comes from a survey administered by the

Collaborative on Academic Careers in Higher Education (COACHE). COACHE began studying

postsecondary faculty in 2003 under the guise of the Study of New Scholars, a project funded by

the Ford Foundation and Atlantic Philanthropies (COACHE, 2008). The Study of New Scholars

researchers developed a survey instrument that is now used annually by the COACHE

researchers to survey pre-tenure faculty members at the consortium of institutions involved with

the project. The design of the survey involved a rigorous pilot study using focus groups and

interviews. The survey is administered on the Internet and was designed to aid institutions in the

recruitment and retention of faculty members. In its entirety, the questionnaire consists of 139

questions unevenly divided between six categories: demographic background; tenure; the nature

of your work; policies and practices; climate, culture, and collegiality; and global satisfaction.

The complete instrument from the 2008 administration is included as Appendix B. I created a

Zoomerang online survey using the questions from the 2008 COACHE survey so that the

interviewees could complete the questionnaire. The data from the interviewees' questionnaires

was merged with the preexisting COACHE dataset; specifics about this merge are discussed later

in this chapter.

Interview Data

The qualitative data collected in this study come from a semi-structured interview

protocol developed expressly for this study. Other studies have used similar questions but the

questions used in the present study specify the field of mechanical engineering and point the

interviewees to discuss experiences related to the research questions (see Goodman Research Group, 2002; Monhardt, Tillotson, & Veronesi, 1999). The interview protocol consists of nine questions that inquire about three topics: experiences as a mechanical engineering faculty member; availability of resources; and opinions about the departmental climate. The complete interview protocol is included as Appendix A.

Description of the Participants

The following sections provide a description of the interviewees and the questionnaire respondents. All of the interviewees responded to the survey prior to being interviewed. In addition, the COACHE collaborative provided me with a dataset that included many years of questionnaire data that they collected from tenure-track faculty members at a large set of institutions across the United States. Faculty members included in the COACHE dataset were identified and contacted by COACHE based on the faculty member's institutional participation in the collaborative. I parsed the COACHE questionnaire data to eliminate all responses other than those of mechanical engineering faculty members for the purposes of this study and this process is discussed in detail later in this chapter. Additional information about the participants for both of the data sources is discussed completely in the following two sections.

Interviewees

The interviewees include 14 faculty members who participated in the pilot study in 2008 as well as 14 additional faculty members. I selected the faculty members using a multi-step process when I began the pilot study, and revisited this process when I began the current study. In 2008, I developed a list of institutions that have mechanical engineering departments using the American Society of Engineering Education's *Profiles of Engineering and Engineering Technology Colleges* publication (ASEE, 2006). I then reviewed each institutions mechanical

engineering departmental website to determine the total number of female faculty members residing in the department of mechanical engineering. I revisited these websites when I began the current study to update my faculty member lists. Faculty members appointed primarily in another department, but jointly in mechanical engineering were counted and their field of research was noted. The goal of this process was to find departments that have at least two female faculty members in the department of mechanical engineering so that I could get more than one individual's perspective. A regional summary using the same regions defined in the U.S. Department of Education's Integrated Postsecondary Education Data System (IPEDS) (U.S. Department of Education, National Center for Education Statistics, IPEDS, 2005), of the institutions that fall within these guidelines is included in Table 1.

Table 1. Regional summary of potential institutions with >2 female mechanical engineering faculty members

Region	Total # of Institutions	% of Institutions with ME Departments	# of Institutions with 2+ Female ME Faculty Members
New England	25	8.3%	5
Mideast	54	17.9%	21
Southeast	57	18.9%	14
Great Lakes	54	17.9%	19
Plains	21	7.0%	6
Rocky Mountains	16	5.3%	7
Southwest	31	10.3%	9
Far West	43	14.3%	16
TOTAL	**301**		**97**

Once this list was compiled, I selected ten institutions of varying types with at least two female faculty members in the mechanical engineering department. I selected institutions that had large numbers of female faculty members in the mechanical engineering departments so that the chance of scheduling an interview was increased. The institutional breakdown by region is as follows: two institutions in the Southeast; Great Lakes; and Far West; three institutions in the Mideast; and one institution in the Plains. The geographic breakdown of the universities and associated faculty members who agreed to participate in the study is shown in Table 2.

Table 2. Geographic location of universities and faculty members

	# of Universities	# of Faculty Members
Mideast	3	8
Southeast	2	6
Great Lakes	2	5
Plains	1	4
Far West	2	5
TOTAL	10	28

When I began the current study I started recruiting participants by contacting all of the pilot study faculty members by email. The goal was similar to that of the pilot study, namely, to have four participants per institution, two female and two male faculty members. This goal was not realized, but I did have participants from each of the ten geographically diverse institutions. Many of the pilot study faculty members expressed an inability to participate in the current study. In some cases I was able to replace them with other faculty members from their institution. I also began emailing participants in the Far West region since those institutions were newly selected as part of the current study. As mentioned previously, I began scheduling interviews in July 2009. By the end of September I had interviewed 13 faculty members from

eight institutions. This meant I had five institutions with only one faculty member who had

agreed to an interview. Though I was unable to schedule many interviews in October and

November, the end of semester facilitated my scheduling an additional 15 interviews that were

completed by the first week in February. After an initial email contact, I called the potential

participant in an attempt to set up an interview date and time and answer any questions the

participant might have. Prior to the interview, I sent an email to the participant and included an

IRB release letter stating the goals of the study, the risks of participation in the study, and

requesting clearance to audiotape the interview. I also included in that email a link to the online

survey and requested that the participant complete the survey prior to the scheduled interview.

The purposeful goal to sample a minimum of two male and two female professors from

each university was selected to include a diverse group, specifically including a representation of

professors from different nationalities and faculty ranks, and from universities that are both

public and private. Though the diversity at a single institution may not have been achieved, the

overall sample did have a good representation with respect to nationality and rank (see Tables 3

and 4). The sample also included professors from a variety of academic backgrounds and

mechanical engineering disciplines.

Table 3. Participant distribution by academic rank

	Female	Male	TOTAL
Assistant	6	4	10
Associate	4	3	7
Full	3	8	11
TOTAL	13	15	28

Table 4. Participant distribution by nationality

	Female	Male	TOTAL
United States	9	10	19
International	4	5	9

Questionnaire Respondents

Most of the quantitative data for this study were obtained from Harvard University's

Collaborative on Academic Careers in Higher Education (COACHE) research group. The

COACHE dataset that was used for this study came from the *Survey of Tenure-Trace Faculty*

Job Satisfaction (COACHE, 2007) and consisted of data from five years of surveys of tenure-

track faculty. These surveys collected data on faculty members' demographic characteristics,

academic background, employment history, current institution characteristics, nature of the

workplace, and job satisfaction. Data for this study were drawn from COACHE's administration

of the survey in 2005, 2006, 2007, 2008, and 2009 and my administration of the survey to the

Young sample in 2009-2010.

The COACHE dataset includes responses from over 15,000 faculty members employed at

collaborative institutions across the country. At the time of fulfillment of the data request, the

collaborative included 127 colleges and universities who are interested in learning about their

academic workplace and how to make the workplace more attractive and equitable for tenure-

track faculty members (COACHE, 2008). These institutions provide the COACHE researchers a

list of tenure-track faculty members and then the COACHE researchers send out an electronic

link to the questionnaire. As stated earlier, the interviewees also completed the questionnaire to

allow comparisons between the total survey population and these individuals in order to confirm

the use of the interviewee responses as a representative sample of the population.

Process Used to Parse the COACHE Dataset

The data request delivered by COACHE included about 3,000 samples per year for each of the five years of data collection. Each year the survey was administered to all tenure-track faculty members at each university, but the current study only looks at mechanical engineering faculty members. The descriptive characteristics of the sample were calculated and then the sample was reduced to leave only mechanical engineering faculty members to be analyzed for this research study. Parsing the dataset to include only mechanical engineering faculty members involved a five-step process. First, the data were sorted by "Academic Area Code," a field defined by the COACHE researchers. The "Academic Area Code" field includes twelve categories, and engineering, computer science, mathematics and statistics are grouped in the same category (i.e., category 16 in this dataset). Second, all data points that did not have the engineering, computer science, mathematics and statistics category designation were deleted. The third step in the process was to sort the data by "Classification of Instructional Programs" or CIP code, a designation defined by the National Center of Education Statistics (NCES). Respondents were asked to input the first two digits of the NCES code, which includes all engineering fields (i.e., code 14). In step four all data points that were not identified as CIP code 14 were deleted. Since the CIP code includes all engineering fields, it was necessary to add a field to the dataset to divide the engineering data into sub-fields; this was the fifth step in the processing of parsing the data. In order to complete this step, I used two fields that the survey respondents were asked to type into the survey: department and school (or college) within the institution. Using these two fields I assigned each respondent a code representing the appropriate field within engineering. When it was difficult to determine whether a respondent was a mechanical engineering faculty member, I erred on the side of caution and did not assign

that respondent to the mechanical engineering subset. The final sample of mechanical

engineering faculty members from the COACHE data request included 209 respondents. Parsing

completed, I prepared the survey data file from the interview participants to match the coding of

the COACHE data file and finally merged the two files.

Description of Combined Quantitative Dataset

The full quantitative dataset included both COACHE administered survey data and data

collected using a Zoomerang survey I created that matched the 2008 COACHE survey. As noted

earlier, the Young dataset included 13 female and 15 male mechanical engineering faculty

members who were employed at ten institutions across the United States. There were a

minimum of two and a maximum of four faculty members representing each institution in the

Young dataset, with the median number of three faculty members. The COACHE dataset

included 40 female and 169 male mechanical engineering faculty members who were employed

at 66 institutions across the United States. There was a minimum of one and a maximum of

eleven faculty members representing each institution in the COACHE dataset, with the median

number of three faculty members. Therefore, the combined quantitative dataset included a total

of 237 participants, of which 22.4% are female. Though this percentage does not accurately

portray the population of female mechanical engineering faculty members across the United

States since it is almost four times higher, it will serve the purpose of providing sufficient data

for this study.

Data Analysis Procedures

Analysis of data from an explanatory mixed-methods study is typically done sequentially

beginning with the quantitative data source and then finishing with the qualitative data source

(Creswell & Plano Clark, 2007). For the current study, quantitative and qualitative data were

analyzed separately. For the quantitative data, analysis included a statistical description of the data and testing for differences in frequency of response. Findings from the quantitative analysis were used to inform the analysis of the qualitative data. Analysis of the qualitative data involved coding the data, developing themes, and then relating the themes. The theme development occurred by way of the constant comparative method (Strauss & Corbin, 1990), which is typically used in multi-site studies. This analysis method began during data collection, and involved continuously looking for key issues that arise in the data. These issues became the general categories in which to focus the analysis. As the categories evolved, data collection broadened on these themes (Strauss & Corbin, 1990).

Quantitative Data Analysis

The quantitative data was analyzed by first calculating descriptive statistics and then calculating chi-square statistic. Descriptive statistics were used to provide a simplified numerical illustration of the data. The data in this study were described using sample sizes, frequencies, medians, and means. The descriptive statistics for the demographics of the participants in the study are included in tables later in this chapter and the descriptive statistics for the survey data are included in Chapter IV and V. Chi-square statistical tests were used for this study because the data are on a nominal scale. Data that are nominally scaled are put into categories that are mutually exclusive (Sprinthall, 2007). The chi-square statistic is used to compare the frequency of occurrence of nominal data that are arranged by category (Sprinthall, 2007). The nominal data used in the current study include: academic rank (assistant, associate, full); gender (female, male); level of satisfaction (very satisfied, satisfied, neither satisfied nor unsatisfied, unsatisfied, very unsatisfied); level of agreement (strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, strongly disagree); level of importance (very

important, important, neither important nor unimportant; unimportant; very unimportant); and, level of effectiveness (very effective, effective, neither effective nor ineffective, ineffective, very ineffective). I used SPSS to do the analysis, and include the information about how to interpret chi-square in the next few paragraphs.

The chi-squares that were calculated for the current study all included a minimum of two sample groups (gender or academic rank) that were compared on the distribution of frequencies reported for the COACHE survey items. Using SPSS, the data are analyzed using the Crosstabs procedure, which creates a cross-tabulation of the data. In the Crosstabs program there is an option to calculate chi-square (χ^2) statistic, and the output includes the degrees of freedom and the level of significance. By evaluating the level of significance, you can determine whether there are significant differences between the groups. A significance level of less than .05 is considered significant for the current study. The descriptive statistics were calculated using the Frequencies procedure in SPSS, and histograms were created as an option in this procedure.

Qualitative Data Analysis

The qualitative data was analyzed in a multi-stage process, using the Acker's theory of gendered organizations (1990, 1992) as the framework to guide the analysis. First I read through all of the data to get a sense of the participants' viewpoints, then I read through the data again while keeping in mind how the data may be representative of any of the following processes of gendering: the creation of divisions along gender lines; the construction of images that reinforce or oppose the divisions; the social interactions between individuals; or, the construction of gendered identities (Acker, 1990). During this reading of the data I began marking passages that seemed to highlight these processes of gendering. I continued to read through the data additional times in order to identify similarities and differences among the participants and begin to group

data into themes. As I analyzed the interviews I looked for parallels in the way the participants

answered questions as a way to define the categories of themes in the participants' own words. I

continued analysis by comparing the responses of the participants to see if there were differences

by gender, rank, or university affiliation in the responses and made note of these. I also looked

for anomalies or outliers whose perceptions differed from other participants to help ensure

validity of the analysis (Silverman & Marvasti, 2008). I continued to refine the analysis by

relabeling categories as I identified additional data that represented processes of gendering and

helped to further explain the dataset as a whole.

<div align="center">Similarity between COACHE dataset and Young dataset</div>

The first statistical analysis was calculated to determine whether the Young interview

participants' COACHE data were similar to the larger COACHE mechanical engineering

participants' dataset. Determining the similarity between the two datasets was a necessary step

to complete the argument for the use of a small number of interviews as representative of a

greater population. Since the main focus of the current study was faculty satisfaction, I only

used the 17 survey items that specifically asked about level of satisfaction for this initial analysis.

One item, #28B in Appendix B, was not included because this item was not included in two of

the COACHE survey administrations, which eliminated 91 respondents from the sample.

Therefore, I continued the analysis with 16 items, #28-33 in Appendix B. The response options

for these questions were on a 5-point Likert scale where the options are the following: 1) very

dissatisfied; 2) dissatisfied; 3) neither satisfied nor dissatisfied; 4) satisfied; 5) very satisfied.

Likert scale data is ordinal, and in most instances does not follow a normal distribution, hence

parametric tests are likely not reliable for the individual questions (Sprinthall, 2007; Vincent,

2005). I reviewed the histograms of the 16 questions and found that the answers to these

questions were not normally distributed. A mean score for all 16 items was then calculated and rounded, and a histogram of this score was more normally distributed than the individual items, but is still negatively skewed for both samples (see Figure 7).

Figure 7: Histogram of mean of satisfaction questions for COACHE and Young samples
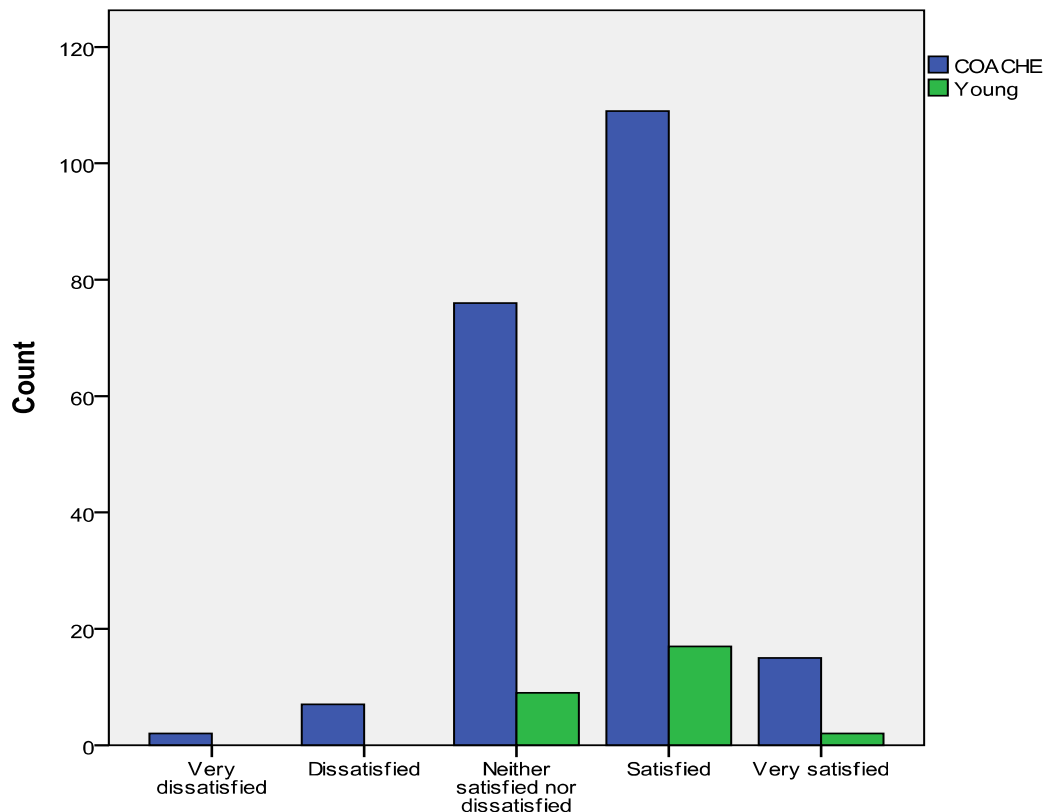
To test for independence of the samples, I used SPSS to perform a cross-tabulation of the data in a contingency table and compute the expected values for each cell in the table (see Table 5). This process compares the observed values for each cell with the expected values "to determine how well these observations 'fit' the expectations" (Sprinthall, 2007, p. 366). A 2 x 5 chi square was computed comparing the frequency of each satisfaction category between the COACHE and Young datasets. The difference was found not to be significant, ($\chi^2_{(4)} = 7.652$, p = .364). This suggests that the COACHE mechanical engineering faculty dataset and the Young interview

dataset are statistically similar. Therefore they will be discussed as one complete dataset

(N=237) for the rest of this analysis.

Table 5. Crosstabulation of mean of satisfaction questions #28-33 by dataset

| | | | Coache or Young | | |
			COACHE	Young	Total
Mean of Satisfaction Questions #28-33	Very dissatisfied	Count	2	0	2
		Expected Count	1.8	.2	2.0
	Dissatisfied	Count	7	0	7
		Expected Count	6.2	.8	7.0
	Neither satisfied nor dissatisfied	Count	76	9	85
		Expected Count	75.0	10.0	85.0
	Satisfied	Count	109	17	126
		Expected Count	111.1	14.9	126.0
	Very satisfied	Count	15	2	17
		Expected Count	15.0	2.0	17.0
Total		Count	209	28	237
		Expected Count	209.0	28.0	237.0

Demographic Characteristics of the Sample

To begin the description of the sample characteristics, I tabulated frequency counts for

each question. The tabulations were done with the dataset as a whole and then with the dataset

grouped by gender. To give a better sense of the population discussed in this chapter, the

following sections detail the demographic characteristics of the faculty members and their

institutions.

Faculty Member Characteristics

The majority of respondents, 198 (83.5%), were assistant professors because the

COACHE survey was designed to measure satisfaction of tenure-track faculty, and was therefore

not sent out to tenured faculty on a widespread basis. The majority of respondents were also

male (77.3%). The faculty member rank distribution by gender is shown in Table 6.

Table 6: Distribution of faculty members by rank and gender

	Female (%)	Male	Total
Assistant Professor	45 (19%)	153	198
Associate Professor	5 (2.1%)	22	27
Professor	3 (1.3%)	9	12
Total	53 (22.4%)	184	237

As with the other survey items, there were a number of respondents who chose not to answer questions about personal characteristics or in some cases the question was not asked on a particular year of the COACHE data collection. Therefore the demographic data shown in this section do not always report on all 237 participants. I have identified the size of the sample if it differs from the full sample size of 237 throughout the analysis of the demographic questions in this section. Of the respondents who reported their race, 51.4% (113) were white and 37.2% (82) were Asian. The faculty members are mostly U.S. citizens; when parsed by gender the percentages of U.S. citizens are 51.6% of the male faculty members and 73.6% of the female faculty members. A chi-square calculation shows a statistically significant difference between male and female faculty members in their citizenship status ($\chi^2_{(1)}$ = 7.254, p = .007, n = 233). This indicates that the female faculty members surveyed are less likely to be non-U.S. citizens than the male faculty members who were surveyed.

Respondents were asked a number of questions with regard to their household demographics. Eighty-seven percent (198) of respondents were married or have a partner and many have children. The analysis also showed that approximately the same percentages of female and male faculty members reported having or not having a spouse or partner, as shown in Table 7, where more faculty members of both genders have a partner or spouse. A chi-square calculation showed no statistically significant difference between male and female faculty

members with regard to whether or not they have a partner or spouse ($\chi^2_{(4)} = 0.094$, p = .954). Of

particular note here, a slightly higher percentage of female assistant professors reported a partner

or spouse, which differs from previous research findings (see Ali (2007)). About 13% more

women than men have no children and similarly men were ten percent more likely to have

between one and three children than women, see Table 8 for more detail. A chi-square

calculation showed no statistically significant difference between male and female faculty

members on whether or not they have children ($\chi^2_{(2)} = 4.017$, p = .134) or on the number of

children reported ($\chi^2_{(7)} = 5.009$, p = .659). Participants were also asked to report on whether or

not they have other dependents not including children. Thirty-one percent of male faculty

members who responded to this question reported having at least one dependent compared to

11% of female faculty members. A chi-square calculation showed a statistically significant

difference between male and female faculty members on whether or not they have dependents

($\chi^2_{(2)} = 9.919$, p < .01, n = 236).

Table 7. Spouse or partner status reported by faculty members

	Male		Female	
	Spouse/ Partner	No Spouse/ Partner	Spouse/ Partner	No Spouse/ Partner
Assistant Professor	125 (67.9%)	21 (11.4%)	39 (73.6%)	5 (9.4%)
Associate Professor	20 (30.9%)	1 (5.4%)	3 (5.7%)	1 (1.9%)
Full Professor	8 (4.3%)	1 (5.4%)	3 (5.7%)	0 (0%)
Total	153 (83.2%)	23 (12.5%)	45 (84.9%)	6 (11.3%)

Note. There were 10 participants who chose not to respond to this question. The percentages were calculated based on the full number of participants in each category (i.e., 184 male and 53 female participants).

Table 8. Number of children reported by faculty members

	0	1-3	4+	Missing or Did Not Respond	
Male	44 (23.9%)	113 (61.4%)	4 (2.2%)	23 (12.5%)	184
Female	20 (37.7%)	27 (50.9%)	1 (1.9%)	5 (9.4%)	53
Total	64 (26.9%)	141 (59.2%)	5 (2.1%)	28 (11.8%)	237

Of interest with regard to post-doctoral appointments prior to taking a tenure-track faculty member position, 48.9% of male respondents held a post-doctoral position, whereas only 37.7% of female respondents held one. Analysis of these data indicate that there were no statistically significant differences between male and female faculty members regarding whether they held a post-doctoral position as indicated by chi-square values, ($\chi^2_{(1)} = 2.912$, $p = .088$, $n = 198$). I note here that this question was not asked during the 2009 COACHE data collection cycle, accounting for all but one of the non-respondents.

Institutional Characteristics

Eight faculty members in the sample who were all employed at the same institution did not respond to the questions about the institutional characteristics. Sixty-one percent of the remaining 75 institutions were classified as "Research University/Very High Research Activity" (RU/VH) and 26.7% were classified as "Research University/High Research Activity" (RU/H), and the rest of the institutions held other classifications including: "Doctoral/Research University," "Master's Colleges and Universities/Larger Programs," "Baccalaureate Colleges—Arts & Sciences," and "Baccalaureate/Associate's Colleges" according to the Carnegie classification of research intensity. Most of the institutions (74.7%) were public and the majority of the public institutions, 37.5% were in the Southeast, followed by the Plains region at 17.9%. The private institutions included in this study followed a different pattern. Whereby 31.6% were

located in the New England region, followed by 26.3% of the private institutions located in each

of the Mideast and Great Lakes regions. The following table (Table 9) details the regional

locations of the institutions, what states are included in each region, and whether they are private

or public. Table 10 shows the distribution of faculty members across the country using the same

regional locations as Table 9.

Table 9 Regional distribution of institutions included in the study

	Public				Private				Total (%)
	RU/ H	RU/ VH	Other	Total (%)	RU/ H	RU/ VH	Other	Total (%)	
New England (CT, ME, MA, NH, RI, VT)	1	1	1	3	2	4	0	6	9 (12.0%)
Mideast (DE, DC, MD, NJ, NY, PA)	0	2	2	4	2	2	1	5	9 (12.0%)
Southeast (AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, WV)	10	8	3	21	0	2	0	3	24 (32.0%)
Great Lakes (IL, IN, MI, OH, WI)	1	6	0	7	0	5	0	5	12 (16.0%)
Plains (IA, KS, MN, MO, NE, ND, SD)	2	8	0	10	0	0	0	0	10 (13.3%)
Rocky Mountains (CO, ID, MT, UT, WY)	0	2	0	2	0	0	0	0	2 (2.7%)
Southwest (AZ, NM, OK, TX)	2	2	0	4	0	0	0	0	4 (5.3%)
Far West (AK, CA, HI, NV, OR, WA)	0	3	2	5	0	1	0	1	6 (8.0%)
Total	16	32	8	56 (74.7%)	4	14	1	19 (25.3%)	75

Note. Participants from one institution did not respond to this question. Regions as defined by U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), (2005).

Table 10. Regional distribution of faculty members included in the study

	Public				Private				Total (%)
	RU/H	RU/VH	Other	Total	RU/H	RU/VH	Other	Total	
New England	1	2	2	5	7	8	0	15	20 (8.7%)
Mideast	0	4	2	6	6	4	3	13	19 (8.3%)
Southeast	40	35	6	81	0	5	0	5	86 (37.6%)
Great Lakes	1	19	0	20	0	15	0	15	35 (15.3%)
Plains	5	34	0	39	0	0	0	0	39 (17.0%)
Rocky Mountains	0	8	0	8	0	0	0	0	8 (3.5%)
Southwest	4	4	0	8	0	0	0	0	8 (3.5%)
Far West	0	7	3	10	0	4	0	4	14 (6.1%)
Total	51	113	13	177 (77.3%)	13	36	3	52 (22.7%)	229

Note. There were eight participants from a single institution who chose not to respond to this question. The percentages were calculated based on the total number of participants who responded to the question. Regions as defined by U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), (2005).
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Summary of Demographic Characteristics

There were more male faculty members participating in the study than female faculty members. Specifically, only one quarter of the respondents were female. The majority of respondents were also assistant professors. Analysis of race indicated that the bulk of respondents were white, with the second largest group being Asian. These two races accounted for almost 90% of the respondents. Most of the respondents were U.S. citizens, and female faculty members were less likely to be non-U.S. citizens than male faculty members. Most of the respondents were married or partnered and have children. There were no significant differences between male and female faculty members with regards to marriage or children. A significantly higher number of male faculty members reported having dependents in their household. A greater percentage of male faculty members held post-doctoral appointments. Almost all faculty members were employed at research universities, with the greatest number employed at institutions classified as having "Very High" research productivity. The majority of

respondents in this study were employed at public institutions, with the greatest number

employed in the Southeast region, followed by the Great Lakes region, then the Plains region.

CHAPTER IV: FINDINGS PART I: CLIMATE AND NATURE OF WORK

Introduction

The purpose of this mixed-methods study is to better understand how female mechanical engineering faculty member experiences in academia affect their career satisfaction. This chapter presents the data analysis related to the following two research questions:

1. Do mechanical engineering faculty members perceive departmental climate differently based on their academic rank?

2. How do male and female mechanical engineering faculty members compare with regard to level of satisfaction with the nature of their work?

In particular, this chapter details the analyses of both the quantitative and qualitative data related to faculty members' perceptions of departmental climate, how departmental climate affects satisfaction, descriptions of the nature of work, and level of satisfaction with the nature of work. The description of the nature of work data is divided into two parts: day-to-day work and interactions. This chapter presents the broad numeric trends reported by mechanical engineering faculty members which provide generalizable results for policy makers while embedding the detailed experiences of the individual mechanical engineering faculty members to add explanatory power to these quantitative findings. The analysis of survey data is presented first, followed by the qualitative analysis that builds on and refines the quantitative analysis. This chapter begins with a presentation of faculty members' perceptions about departmental climate, followed by faculty members' reported satisfaction with the nature of their work.

Perceptions of Departmental Climate

Analysis of departmental climate related to the first research question began with an examination of a subset of eight survey questions that fall under the "Climate, Culture, and

Collegiality," "Global Satisfaction," and "Policies and Practices" sections of the COACHE

survey and continued with analysis of the interview data associated primarily with question 1 of

the open-ended interview protocol: "Please describe the culture or atmosphere in your

department." (see Appendix A). Of interest in this study was how perceptions differ based on

faculty member rank, so the descriptive statistics based on the survey data that are displayed in

Table 11 are shown by the percentages of faculty members holding each academic rank. The

number of faculty members who responded to each of these survey questions varied, so the total

sample size responding to each survey question is included for reference. Also note that one

survey question was not included as part of the data collection process in 2005 or 2006. The set

of survey questions analyzed in this section had five possible response categories: strongly agree,

somewhat agree, neither agree nor disagree, somewhat disagree, and strongly disagree. A 3 x 5

chi square was computed comparing the level of agreement with each of the cultural sensitivity

survey items among faculty members of three academic ranks. The chi squares for all six survey

questions were found not to be significant and are included in the footnote for Table 11. The

percentages of faculty members who responded to the survey questions show that with respect to

all survey items regarding the sensitivity of the institution or departmental colleagues, the

assistant and associate professors, at very similar rates, do not agree that their institution or

departmental colleagues are respectful of having and raising children or balance. Balance is

defined in this study as a suitable distribution of a faculty member's time between home and

work responsibilities. There is no assumed suitable distribution of time specified in the survey

question related to balance; each faculty member determines what an appropriate distribution is

and whether he or she feels competing demands that are not supported by colleagues. The most

pronounced differences among the ranks of professors relate to the two survey questions

regarding institutional sensitivity toward having and raising children, where over 55% of

assistant professors, and over 60% of associate professors rated these questions as either

"strongly or somewhat disagree" or "neither agree nor disagree" implying that the respondents

did not perceive their institutions to be sensitive with respect to these family issues. With respect

to whether the department treats junior faculty fairly compared to one another, assistant

professors continued to disagree with that assertion at notably higher rates than both associate

and full professors. There are also no significant differences in the ratings of these survey

questions when the faculty member's gender is taken into consideration. The largest discrepancy

in survey ratings by gender of the faculty member was regarding whether the department treats

junior faculty fairly when compared to one another. Fifty-four percent of female faculty

members rated this question as either "strongly or somewhat disagree" or "neither agree nor

disagree," while only 34% of male faculty members chose similar ratings. In fact, female faculty

members "strongly or somewhat disagree" that their department treats junior faculty fairly when

compared to one another at more than twice the rate of male faculty members (27 and 12%,

respectively) implying that male faculty members are far less likely to perceive any inequality at

the department level.

Table 11. Percentage of faculty members who agree with cultural sensitivity questions by rank

	Strongly Agree (Full / Assoc. / Asst.)	Somewhat Agree (Full / Assoc. / Asst.)	Neither Agree nor Disagree (Full / Assoc. / Asst.)	Somewhat Disagree (Full / Assoc. / Asst.)	Strongly Disagree (Full / Assoc. / Asst.)	χ^2 (df, N)
My institution does what it can to make **having children** and the tenure-track compatible.	20 / 10 / 8	**70 / 30 / 37**	0 / 25 / 24	0 / 15 / 19	10 / 20 / 12	9.987 (8, *N*=170)
My institution does what it can to make **raising children** and the tenure-track compatible.	0 / 11/ 5	**60 / 11 / 31**	30 / 37 / 27	**0 / 21 / 21**	10 / 21 / 16	10.19 (8, *N*=177)
My departmental colleagues do what they can to make **having children** and the tenure-track compatible.	22 / 19 / 15	**56 / 24 / 32**	11 / 29 / 32	11 / 14 / 12	0 / 14 / 9	5.030 (8, *N*=173)
My departmental colleagues do what they can to make **raising children** and the tenure-track compatible.	11 / 14 / 14	**44 / 29 / 31**	33 / 29 / 31	11 / 14 / 12	0 / 14 / 11	1.946 (8, *N*=177)
My colleagues are respectful of my efforts to balance work and home responsibilities.ₐ	**30 / 0 / 24**	40 / 42 / 39	30 / 42 / 20	0 / 17 / 11	0 / 0 / 5	8.064 (8, *N*=121)
On the whole, my department treats junior faculty fairly compared to one another.	**18 / 47 / 27**	**73 / 42 / 42**	0 / 5 / 10	0 / 5 / 10	9 / 0 / 11	9.636 (8, *N*=111)

[a]Not collected in 2005 or 2006.

When asked in the survey to rate their institution as a place for pre-tenure faculty members to work using a five-point scale (great, good, so-so, bad, awful), approximately the same percentage of assistant and associate professors rated their institution as good or great (72 and 74%, respectively), while 92% of full professors gave the same rating. On the other end of the spectrum similar percentages of professors at all academic ranks rated their institution as "bad" or "awful", with seven percent of assistant, four percent of associate, and eight percent of full professors choosing that rating. When asked if they would recommend their department as a place to work for pre-tenure faculty members, the percentage of assistant and full professors who

said they would not recommend their department as a place to work was about half the percentage of associate professors who said the same (six, eight, and 15%, respectively). The rest of the assistant, associate, and full professors who responded to this survey question were split between recommending their department with reservations (45, 31, and 17%, respectively) and strongly recommending their department as a place to work (49, 54, and 75%, respectively), with the majority of full professors holding a positive view of their department as a good place for pre-tenure faculty members. This is of interest because typically when departments hire new faculty members, they ask their current faculty members to do some recruiting. If almost half of the assistant professors would recommend their department with reservations, they may not be the best advocates for recruiting new faculty members. In addition, departments may engage assistant professors during on-site interviews as interviewers or guides for a recruited faculty member, and these data imply that full professors, who strongly recommend their department at a much higher rate than either assistant or associate professors, would be better suited in this capacity. Or, from the perspective of the recruited faculty member, the assistant professors would be the ones who the recruited faculty member could ask to identify negative aspects of the department, since they are more likely than associate and full professors to have reservations with their department.

Assistant Professors' Perceptions of Departmental Climate

The analysis of the in-depth interview questions provided data that build on the quantitative analyses described earlier in this chapter. The next three sections describe the interviewees' perceptions of departmental climate, and how their experiences in their departments affected their career satisfaction. The ten assistant professors who were interviewed were not consistent within their rank in terms of the ways they discussed the climate and culture

within their departments. Most of the assistant professors began by describing their department as collegial and supportive. Some immediately focused on the mentoring they had received as an example of this support, while others discussed support from colleagues that was available if they needed coverage for a class or assistance with developing a course. A few assistant professors described their colleagues as "a great bunch of people" (FT1a, line 5) or "friendly" (FT3a, line 3; MT5, line 43), and at least two assistant professors mentioned that they believe that when hiring new faculty members there is an emphasis on hiring people who want to work together. One female assistant professor summed this up when she said, "while academic credentials are important I think there seems to be a strong emphasis here on how the person would fit within the department, you know, whether they'd be open to collaborative work with other colleagues (FT1a, line 7). The process of purposefully hiring individuals whose personalities or working styles are similar falls under the second dimension of gender hierarchy in the theory of gendered organizations, whereby images are constructed that reinforce or oppose divisions along gender lines (Acker, 1990). That both male and female faculty members described this behavior at their institutions suggests that the gender hierarchy that was in place at these institutions is now being opposed by an emphasis on collaborative, friendly colleagues, irrespective of sex or race. A few assistant professors from smaller departments (i.e., 15-25 faculty members) mentioned that the close proximity of faculty member offices within a building helped to create a "good sense of community and collegiality" (MT5, line 39). These faculty members described the faculty members' offices within the department as all on the same hallway, or taking up one or two floors of a building, and how this makes it easy to randomly chat with colleagues in the hall as you walk around to get mail or coffee. Not all of the interview respondents were as positive. Two assistant professors described the politics within their

department and how it had a detrimental effect on the climate. These two assistant professors' descriptions made it clear that the overall atmosphere in their department was good, but that not all of their colleagues were very collegial. Overall there were more positive responses by the assistant professors who were interviewed with respect to climate and culture than was evident in the survey data. The assistant professors who were interviewed tended to connect the negative aspects of culture to a subset of their colleagues, whereas a greater percentage of assistant professors in the larger survey sample said that their institution was less culturally sensitive than their engineering department (see Table 11).

Associate Professors' Perceptions of Departmental Climate

The seven associate professors who were interviewed were less overtly positive about the culture in their departments than the assistant professors. Three of the associate professors described their departments as "collegial," and most of them described their colleagues as being open to collaboration. Only one associate professor used the term "supportive" to describe his department. One female associate professor described her colleagues as "individualists" and her department as "isolated," explaining "everybody goes in their office and closes their door and looks really busy all of the time or just isn't around" (FC5, line 18). Another female bluntly stated that her department is "what people would think of as a stereotype of mechanical engineering. More male oriented…less supportive of family issues and diversity issues and a lot of unnecessary competition" (FC9, line 24). In contrast, two associate professors specifically referenced the lack of aggressiveness or competitiveness within their department when describing the culture. One of these faculty members expanded on the lack of competitiveness when he stated, "when we hire a faculty member it's, I believe, everyone's intention that that faculty member will be here for thirty years. So we want to do everything we can to make sure

that faculty succeeds" (MC2, line 20). These two competing viewpoints about competitiveness by male and female associate professors are explained by two aspects of gendering: construction of divisions and construction of symbols (Acker, 1990). There is an apparent discrepancy by gender of faculty member in what would be considered allowed behavior (i.e., competitiveness and lack of support) and males seem to be less cognizant of the discrepancy. In addition there is a discrepancy by gender of faculty member in the ideology with respect to expectations of support and collegiality, where the female faculty members who were quoted earlier iterate an ideology of individual researchers who are not supportive of others, which is in contrast with the alleged sensitivity male faculty members' reported as part of the institutional and/or departmental climate. In most cases the description of culture by associate professors was brief and led directly into a discussion of the effectiveness or ineffectiveness of the departmental leadership, which is discussed later in this chapter. Both the interview and survey data collected from associate professors is quite consistent. Associate professors were less positive about culture throughout the interviews and a higher percentage of associate professors indicated that their institution and department were less culturally sensitive than did assistant professors (see Table 11).

Full Professors' Perceptions of Departmental Climate

The eleven full professors who were interviewed ranged from six to twenty-five years at their current institution, with a median of 16 years. When asked about the culture and atmosphere in their departments, only four professors specifically described their departments as collegial. In terms of atmosphere, all of the professors who talked about collegiality, and four additional professors, described a good or positive atmosphere within the department. Four of the full professors noted that the environment had undergone significant change for the better

during the time spent at their university. One female noted a few subtle improvements since the time she started with respect to awareness of her colleagues regarding the need for balance in family life and the lack of diversity in the student and faculty ranks within the college, but she also noted that "there are a lot of unintended biases and cultural things that…make it very difficult for women to succeed" (FP7, line 23). She continued by noting that she did not believe her department had a good track record for tenuring their female faculty members, and she also noted that there are many non-tenure-track lecturer positions that, in general, are held by PhD-level females. Two of the male professors who described significant change in their departments noted that this was a result of many faculty members leaving because of retirements or getting chaired professorships at other institutions resulting in an influx of young faculty members. One professor noted, "we've made a concerted effort to hire people that we really want to work with. So, just having an impressive resume isn't enough for us to hire somebody" (FP10, line 155). This professor's statement suggests that at one time the rationale for hiring an individual may have been based on credentials alone and the hiring committee may not have taken into consideration the potential and willingness of a faculty member to be a collaborative colleague. One professor talked about culture in terms of "freedom to do what you want to do…there's no micromanagement in the sense that no one is looking over your shoulder and telling you that you need to work in this area…[or] do this kind of research" (MP3a, line 6). Another professor described the culture as "distant comradeship" where there is "mostly a tendency to work individually" (MP8, line 4). This professor recognized an increase in collaboration, but believed this was not yet embedded in the culture. In summary, the full professors described their departments as having a good atmosphere or being collegial, but in some cases this may have been because of the change that the department went through over the duration of their

employment there. The interview data were very consistent with the survey data collected from full professors. Relating this analysis back to the first research question covered in this chapter, mechanical engineering faculty members do perceive departmental climate differently based on their academic rank. In general, full professors were more overtly positive about the culture and climate within their institution and department, and they were much more likely than both assistant and associate professors to report that both their institution and department were culturally sensitive (see Table 11). As noted in Chapter III, the theory of gendered organizations assumes that all organizations are gendered, and that "advantage and disadvantage…are patterned through and in terms of a distinction between male and female" (Acker, 1990, p. 146). Recognizing that only 9.8% of tenured or tenure-track mechanical engineering faculty members are female, with the bulk of full professors being male, the pattern of collegiality and cultural sensitivity in mechanical engineering is greatly defined by a male-dominated subset of the population. The faculty members in this study disagree by rank with respect to the presence of divisions that exist with respect to allowed behavior, specifically with regard to sensitivity to family issues and competitiveness. These divisions are reinforced by an ideology that may, on the surface, suggest that a department and institution are supportive, but these views are not shared by the assistant and associate professors. It was apparent based on the interview data that changes in ideology and divisions based on gender are still in process within some institutions and departments, and many of the full professors acknowledged that there are still areas in need of improvement.

Summary of Perceptions of Departmental Climate

Perceptions of departmental climate and atmosphere varied both within and across academic rank among the faculty members who were interviewed for this study. The majority of

assistant professors believed their department to be collegial, with only a few describing

detrimental politics within their department. The assistant professors tended to describe the

culture and atmosphere in terms of the amount of support they receive from colleagues, the

amount of informal interaction they have with colleagues, and the ability to collaborate. In

contrast, less than half of the associate professors described their departments as collegial and

only one used mentioned that his department was supportive. Associate professors were more

likely than assistant and full professors to describe the competitiveness, or lack thereof, within

their department when describing the culture and atmosphere. It appears that full professors had

the longevity within departments to be able to address their perceived, substantive changes in

culture and atmosphere over time during their interviews. A handful of full professors described

changes in culture or atmosphere that were positive since they had begun their appointments at

their institutions. In summary, though a majority of faculty members of all ranks describe their

departments as collegial, there were a few associate and full professors who felt differently and

instead described their departments as individualistic. In other words, mechanical engineering

faculty members do indeed differ in their perceptions of departmental culture and climate based

on their academic rank.

<center>Satisfaction with Respect to the Nature of Work</center>

This section presents the data collected from the mechanical engineering faculty

members concerning their levels of satisfaction with the nature of their work, relevant to the

second research question which was restated earlier in this chapter. Though interactions and

relationships with colleagues are considered an integral aspect of the nature of work, these topics

will be discussed separately in the following section. Analysis began with an examination of a

subset of twelve survey questions that fall under "The Nature of Your Work" section of the

COACHE survey and continued with analysis of the interview data associated primarily with questions 8 through 10 of the interview protocol, which are restated below:

- How do you distribute your time among teaching, research, and service? Are your experiences typical?

- How are teaching assignments decided? Are you satisfied with this process?

- How is committee work assigned? Are you satisfied with this process?

As noted on the survey, the items analyzed in this section explore the day-to-day activities of a faculty member. The open-ended interview questions that covered this topic focused on the nature of faculty member work, specifically related to the three areas of service, research, and teaching. Of interest in this study was how satisfaction differs based on sex, so the descriptive statistics based on the survey data that are displayed in Table 12 are shown by percentages of female and male faculty members. The total sample size responding to each survey question is included for reference because the number of faculty members who responded to each of these survey questions varied. Also note that one survey question was not included as part of the data collection in 2005 or 2006. The set of survey questions analyzed in this section had five possible response categories: very satisfied, satisfied, neither satisfied nor dissatisfied, dissatisfied, and very dissatisfied. A 2 x 5 chi square was computed comparing the level of satisfaction with each of the survey items related to nature of work among male and female faculty members. The chi squares for all 12 survey questions were found not to be significant and are included in Table 12. Visual descriptions of the frequency of response for male and female faculty members are included as Figures 8 and 9.

In spite of finding no statistical significance between male and female faculty members for these survey questions, there were interesting differences noted in the percentages, as

discussed in the next few paragraphs. Male faculty members on average reported being satisfied at a higher rate than female faculty members, as shown in Figure 8, where about 40% of males reported feeling satisfied on all of the survey questions. As displayed in Figure 9, female faculty members were much less likely than male faculty members to report feeling satisfied on three survey questions: number of hours worked, amount of time to conduct research, and amount of external funding expected. On each of these three survey questions less than 40% of female faculty members reported feeling satisfied or very satisfied, as shown in boldface text in Table 12. This supports findings reported by the COACHE researchers, who found a significant difference (p<.001) in level of satisfaction between male and female members from all disciplines in both the amount of time to conduct research and the amount of external funding expected (COACHE, 2007). COACHE did not include data about the other survey question in their analysis and they only report data collected from 2005-2007.

Table 12. Chi square statistics comparing percentage of faculty members who are satisfied with

the nature of their work by gender

	χ^2 (df, N)	Very Satisfied (Male / Female)	Satisfied (Male / Female)	Neither Satisfied Nor Dissatisfied (Male / Female)	Dissatisfied (Male / Female)	Very Dissatisfied (Male / Female)
The way you spend your time.	6.660, p = .155 (4, N = 237)	19 / 9	53 / 51	14 / 11	11 / **23**	3 / 6
The number of hours you work.ₐ	4.818, p = .307 (4, N = 146)	12 / **7**	48 / **36**	19 / 23	17 / **32**	4 / 3
The level of the courses taught.	3.363, p = .499 (4, N = 236)	30 / 40	52 / 45	11 / 6	6 / 8	2 / 2
The number of courses taught.	0.886, p = .927 (4, N = 236)	38 / 38	39 / 36	11 / 9	10 / 13	2 / 4
The degree of influence over courses taught.	1.503, p = .826 (4, N = 235)	42 / 48	38 / 31	11 / 14	6 / 6	3 / 2
The discretion over content of courses taught.	8.126, p = .087 (4, N = 235)	50 / 71	41 / 25	5 / 2	2 / 2	2 / 0
The number of students taught.	7.787, p = .100 (4, N = 236)	27 / 17	39 / 51	14 / 13	17 / 9	3 / 9
The quality of undergraduate students taught.	6.508, p = .164 (4, N = 232)	16 / 26	34 / 30	24 / 19	20 / 25	6 / 0
The amount of time to conduct research.	5.687, p = .224 (4, N = 236)	9 / **4**	39 / **28**	11 / 9	34 / **49**	7 / 9
The amount of external funding expectation.	3.910, p = .418 (4, N = 232)	6 / **8**	39 / **29**	29 / 25	18 / **27**	8 / **12**
The influence over focus of research.	7.381, p = .117 (4, N = 237)	39 / 55	44 / 28	7 / 11	9 / 4	1 / 2
The quality of facilities.	1.019, p = .907 (4, N = 236)	19 / 21	36 / 40	20 / 17	18 / 14	8 / 8

ªNot collected in 2005 or 2006.

After further review of the data in Table 12, there is an additional discrepancy with

regard to the percentage of female faculty members reporting levels of dissatisfaction. On four

survey items in Table 12 [shown in boldface text], at least ten percent more female faculty

members than male faculty members reported feeling dissatisfied or very dissatisfied with

respect to the following topics, all of which generally relate to research, and three of which were

mentioned earlier: the way you spend time, the number of hours worked, the amount of time to

conduct research, and the amount of external funding expectations. In fact, although not

significant according to the statistical analysis, almost 60% of female faculty members reported

feeling dissatisfied with the amount of time they have to conduct research; a rate of 17% more than males. In addition to the two items noted earlier, COACHE (2007) researchers found significant differences by gender in the reported level of satisfaction on three survey questions where no significant differences were found in the mechanical engineering sample used in this study: the way you spend time (p<.001), the degree of influence over courses taught (p<.01), and the number of students taught (p<.05). Recognizing that the COACHE dataset includes faculty members from all disciplines and the current study focuses solely on mechanical engineering faculty members, this finding suggests that mechanical engineering faculty members may have more freedom to negotiate which courses they teach, the size of their class, and how they spend their time than faculty members from other disciplines.

Figure 8. Percentage of male faculty members who are satisfied with the nature of their work

Figure 9. Percentage of female faculty members who are satisfied with the nature of their work
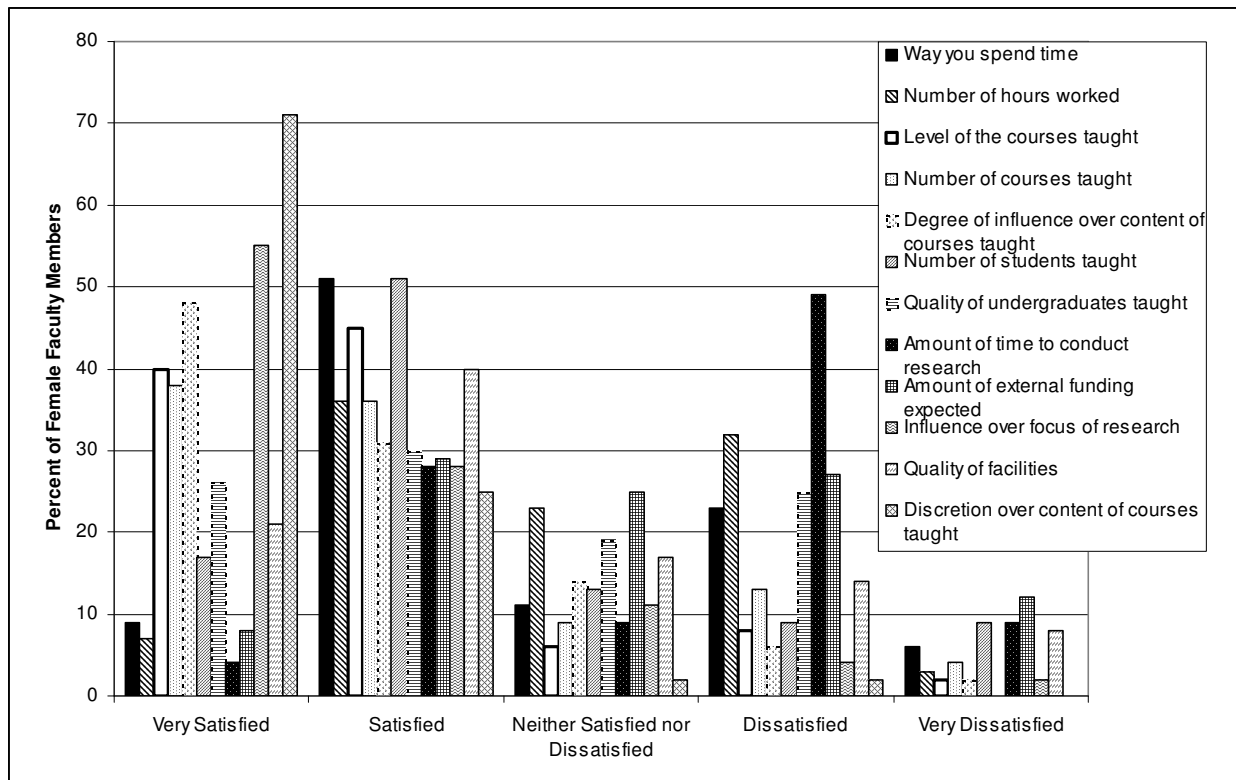
Analysis of interview data regarding the nature of faculty members' work revealed topics similar to those addressed in the survey. Faculty members described the ways they spend their time at work and explained how their time is divided among teaching, research, and service activities. These topics are discussed in the following sections.

Teaching Requirements

The teaching requirements, as reported in the interviews, varied widely by university. One institution that is on a two semester schedule requires faculty members to teach two courses per year. The other nine institutions require either three or four courses per year; two of these institutions are on quarter scheduling and require that one or two courses be taught for each of three quarters. Overall, faculty member responses to the survey show high percentages of faculty members who are satisfied or very satisfied with the number and level of the courses they

have been assigned to teach. Faculty members at four institutions stated that there are lower

teaching requirements for pre-tenure faculty members; in all cases new assistant professors start

with two courses per year and this requirement tends to rise incrementally until the full teaching

load is reached at the point of tenure. Faculty members at three other institutions, and one of the

institutions that has lower pre-tenure requirements, mentioned that there is a prevailing practice

that pre-tenure faculty members are assigned a set of 3 to 4 courses that they teach over and over

until they reach tenure. This practice is looked on favorably by some assistant professors, and it

was mentioned by at least one faculty member who was in favor of implementing this practice at

his university:

> I have friends at other universities…all their advice was, teach your three courses that
>
> you've prepped and teach them over and over and over again until you get tenure because
>
> every new course prep is just—it's a waste of a term essentially. And they're right! And
>
> you know I push for that but, you know, the way our administration is, is they don't agree
>
> with that policy. (MT10b, line 92)

This faculty member was solely responsible for five of the eleven courses in his discipline and

had taught two other courses during his pre-tenure period, which led to his frustration about how

teaching assignments are made. Some faculty members raised the issue of an increased teaching

load if a faculty member's research output is low. One male full professor was staunchly against

this and suggested that there could be a variety of reasons why a faculty member may not have

high research output. He stated,

> I think the problem with that is you get into this situation where um, faculty who are
>
> stuck in the two course per term load, don't get any time off and they'll never get out of
>
> that because they can never get their research up to the point where, you know they get

the benefit of it. So I guess I'm not a big fan of rigid administrative policies and you just

do things by the numbers, uh, because every situation's different, and I think we're kind

of falling into a trap of doing everything strictly by the numbers and that's not a good

thing. (MP4, line 189)

This assessment of policy brings a new wrinkle to the issue whereby rigidity in implementing

policy can be seen as negative and against the collegial, collaborative environment that was

described by the interviewees. This policy of rigidity could be considered a gendered division in

power (Acker, 1990) whereby policies are put in place and maintained though they may be

detrimental to the success of faculty members. Maddock (1999) says that leaders who are

"decisive, competitive, and playing-by-the-rules" (p. 43) take on qualities of a typical male

leader, and that "men and women continue to think that men tend to be better managers because

they demonstrate male responses and qualities" (p. 43). The statement by MP4 suggests the need

for leaders who are flexible and democratic in implementing in policies, two descriptors typical

of women's leadership, which is described by Alvesson and Due Billing (1997) as potentially

"superior…to that of men" (p. 203).

<p style="text-align:center">Service Requirements</p>

Many untenured faculty members expressed low or targeted service requirements as part

of their assigned duties. Some of the duties assigned to untenured faculty members included

committees where they had networking opportunities or sat on graduate student committees

where they could have first pick of incoming graduate students. Faculty at one institution in

particular, disagreed regarding the equity of the assignment of committee work. The female

faculty members reported significantly more committee assignments and had the perspective that

work was not assigned equitably, whereas the male faculty members did not report participating

in much service work and believed that the work was assigned equitably based upon research intensity. Many faculty members discussed their participation on search committees as part of their service to the department or the institution, and noted the massive amounts of time this service activity takes. Of the faculty members who were on search committees, at least two of the assistant professors reporting serving on multiple chair or dean-level search committees in the two years prior which resulted in significant time taken away from their research. The assistant professors spoke very differently about how they were chosen to participate in the search committees, one female stated "those are special [committees] that you're nominated for and then you're asked if you accept the nomination" (FT7, line 442), she was happy that she was selected, and though she served on both the dean and chair search committees, in addition to her other service, she felt that her service load was pretty light in comparison to colleagues she has at other universities. Of note, a female full professor specifically referenced this topic during her interview,

> So they put her [FT7] on the curriculum committee. Um, she was on the Dean's search committee. Now she's on the Department Chair's search committee. There's no way she should be on that committee with the risk she has right now of not being tenured. They did reduce her teaching load, but…I think there's a culture problem there…she clearly knows, I mean I've told her, I've said, if you don't get publications you will not get tenure. (FP7, line 99)

In this case a senior colleague was attempting to give cautionary advice, but it apparently was not heeded by the junior faculty member. Also of note with respect to this institution, the male department chair specifically stated that he tries to "equalize the committee work" (MP7, line 153), which seems to be in conflict with what the female faculty members have reported.

Another assistant professor who had served on five search committees in his five pre-tenure

years argued,

> Search committees are the worst. Um, because you have to review, you know if you
>
> have one open position, you have to review 300 CVs, you have to spend all the time
>
> going through those, picking out who would be good candidates, then you have to do the
>
> phone interviews, then you have to do the campus visits. It's just a gigantic black hole of
>
> time. (MT10b, line 245)

He did not feel that the assignments were equitable as he stated, "…this kind of goes back to if

you're in the good graces with the department head you get better assignments than if you're

not" (MT10b, line 242). In direct contrast with the female assistant professor who viewed

serving on a search committee as an honor, the female full professor and the male assistant

professor both understood that there could be these consequences associated with spending so

much time involved in service to the department or university. Either a faculty member would

have to spend more hours working, leading to more difficulty in balancing work and life, or his

or her research or teaching would suffer because of the lack of time spent in those areas.

Female Faculty Members Roles in the Department

The interviews with female full professors generated interesting findings with regard to

perceived gender differences and the different roles assumed within a department by male and

female faculty members. The female full professors indicated there is often an assumption

within the department that when a new female faculty member comes into the department she

will take care of undergraduate teaching and all of the women in engineering activities, in

addition to assisting with recruitment of a diverse student population; whereas a new male

faculty member is unlikely to be requested to do any recruiting or similar types of service for the

department. The underlying issue seems to be the creation of divisions along gender lines, highlighted by one professor when she stated,

> There's this view that's wrapped up in culture of, when a woman comes in here's what we expect out of them and the expectations are not congruent with what it takes to get tenure….That's the struggle…there are some assistant professors who are male who would no more think about taking a trip to…recruit graduate students, male, female or whatever, than they would think about going to the lake and drowning themselves, you know? Their whole focus is on research and that's what's going to get them tenure.
>
> (FP7, line 134)

FP7's experiences are not atypical to females in academia; Philipsen (2008) detailed the feelings of exploitation of a female assistant professor who is expected to clean up after department meetings and prepare labs for other faculty members and a female associate professor who is expected to take on more service than her colleagues. These examples suggest divisions of labor by gender where "men are almost always in the highest positions of organizational power" (Acker, 1990, p. 146). There were examples of male faculty members who were also assigned what could be considered less desirable service to the department, but these assignments were much more likely to go to female faculty members. If an underlying assumption of mechanical engineering faculty members is that high-quality research and publications are what is required to gain tenure, then the divisions along gender lines described above would greatly interfere with a female faculty member's available time to spend on research-related work. The female full professor quoted above felt that there was not a specified path to tenure, but that male faculty members at her institution tended to focus only on research as a way to get tenure, thus they tended to suggest that female faculty members should do the service that FP7 described above.

Male assistant professors espoused this viewpoint; none of the male assistant professors who were interviewed suggested that anything mattered for tenure purposes other than research and publications.

Time Spent on Research

Many male faculty members in the interview sample expressed that the bulk of their time was spent on research. To further this question, I asked all faculty members how they divide their time amongst teaching, research, and service and the results were in a stark contrast. All male interviewees said that they spend more than 50% of their time conducting research, compared to fewer than half of the female interviewees who reported spending the same amount of time. At the upper end of the spectrum, less than one quarter of male and female interviewees reported that they spend approximately 75% of their time during a typical work week conducting research. Research time included time spent writing proposals for grants, administering grants, working with graduate students, and writing and editing manuscripts, among other things. Of the female faculty members who reported spending a bulk of time on research, none were full professors and all were employed at RU/VH institutions. [RU/VH institutions are defined as very high research activity, doctorate-granting Universities. This includes institutions that awarded at least 20 research doctoral degrees during the update year (excluding doctoral-level degrees that qualify recipients for entry into professional practice, such as the JD, MD, PharmD, DPT, etc.). (http://classifications.carnegiefoundation.org/descriptions/basic.php)] A higher percentage of females than males reported feeling dissatisfied or very dissatisfied with respect to the amount of time they had available to conduct research, in agreement with the interview data analysis. Faculty members of both genders discussed a strong interest in spending less time on

the "soft" aspects of research (e.g., writing proposals, submitting effort reporting, balancing budgets, etc.) and more time actually doing research.

Almost all faculty members interviewed reported that they had adequate facilities and resources for their research; at many universities these facilities were not located in the mechanical engineering department, but because of good relationships and policies within the university they were easily accessed. Of the four faculty members who reported a gap in research facilities or equipment, all but one was employed at an RU/VH institution. One faculty member who is employed at an RU/VH specifically noted the lack of a policy for shared equipment across the university. This analysis confirmed the analysis of survey data reported in Table 12, where it was found that more than half of all faculty members reported being satisfied or very satisfied and only about a quarter of faculty members reported levels of dissatisfaction with the quality of facilities.

Summary of Satisfaction with Respect to Nature of Work

In summary, levels of satisfaction with the nature of work were consistent between male and female faculty members in many areas, but inconsistent with respect to time spent on research and research related activities. Overall, high percentages of faculty members were satisfied with four areas regarding the nature of work: the discretion over the content of courses taught, the level of the courses taught, the influence over the focus of their research, and the degree of influence over courses taught. Higher percentages of female faculty members than male faculty members were dissatisfied about four aspects of their work: the amount of time to conduct research, the amount of external funding expected, the number of hours worked, and the way they spend their work time. Male faculty members were also dissatisfied with these aspects of work, but not to the same extent as the female faculty members surveyed.

Satisfaction with Relationships and Interactions

This section continues the discussion about satisfaction with the nature of work by presenting data covering the areas of interactions and relationships among faculty members. Analysis began with an examination of a subset of six survey questions that fall under the "Climate, Culture, and Collegiality" section of the COACHE survey and continued with analysis of the interview data associated primarily with questions 2 through 7 of the interview protocol, which are restated below:

- Who are the department leaders?

- What is your role in the department?

- What types of interactions do you have with colleagues? Do you tend to initiate interactions or do others?

- When you first started did you find that it was easy to begin collaborating with colleagues?

- Are you satisfied with the number and quality of your relationships with colleagues in your department? In other departments?

- To what extent do you feel that you can do innovative, collaborative research here?

The open-ended interview questions that covered this topic focused broadly on the nature of the interactions faculty members have with colleagues. The descriptive statistics based on the survey data that are displayed in Table 13 are shown by percentages of female and male faculty members because the purpose of this study was to understand how satisfaction differs based on gender. The number of faculty members who responded to each of these survey questions varied, so the total sample size responding to each question is included for reference. The set of survey questions analyzed in this section had five response categories, including: very satisfied,

satisfied, neither satisfied nor dissatisfied, dissatisfied, and very dissatisfied. A 2 x 5 chi square

was computed comparing the level of satisfaction with each of the survey items related to nature

of interactions among male and female faculty members. The chi squares for all six survey

questions were found not to be significant and are included in Table 13.

Table 13. Percentage of faculty members who are satisfied with the nature of their interactions

by gender

	χ^2 (df, N)	Very Satisfied (Male / Female)	Satisfied (Male / Female)	Neither Satisfied Nor Dissatisfied (Male / Female)	Dissatisfied (Male / Female)	Very Dissatisfied (Male / Female)
The interest tenured faculty take in your professional development.	5.336, p = .255 (4, N = 231)	23 / 15	33 / 26	22 / 23	**15 / 26**	7 / 9
Your opportunities to collaborate with tenured faculty.	6.139, p = .189 (4, N = 234)	26 / 17	30 / 27	19 / 14	**16 / 27**	9 / 15
The amount of professional interaction you have with tenured faculty in your department/at your institution.	2.433, p = .657 (4, N = 234)	19 / 13	32 / 36	18 / 13	22 / 25	9 / 13
The amount of personal interaction you have with tenured faculty in your department/at your institution.	4.217, p = .377 (4, N = 229)	22 / 14	31 / 33	28 / 23	**14 / 23**	5 / 8
The amount of professional interaction you have with pre-tenure faculty in your department/at your institution.	1.806, p = .771 (4, N = 231)	29 / 26	39 / 34	18 / 23	11 / 11	3 / 6
The amount of personal interaction you have with pre-tenure faculty in your department/at your institution.	3.325, p = .505 (4, N = 226)	29 / 31	37 / 37	21 / 23	10 / 4	2 / 6

For half of the survey items, those related specifically to interactions with tenured

faculty, at least ten percent more female faculty members than male faculty members reported

feeling dissatisfied or very dissatisfied. In fact, less than 50% of female faculty members

reported feeling satisfied with all four survey questions that relate to interactions with tenured

faculty members [see Table 13 and Figure 10]. In contrast, more than 50% of male faculty

members reported feeling satisfied with interactions with tenured faculty members. Two-thirds

of all faculty members reported feeling satisfied or very satisfied with professional and personal

interactions with pre-tenure faculty members [see Table 13].

Figure 10. Percentage of faculty members who are satisfied with the nature of their interactions

by gender
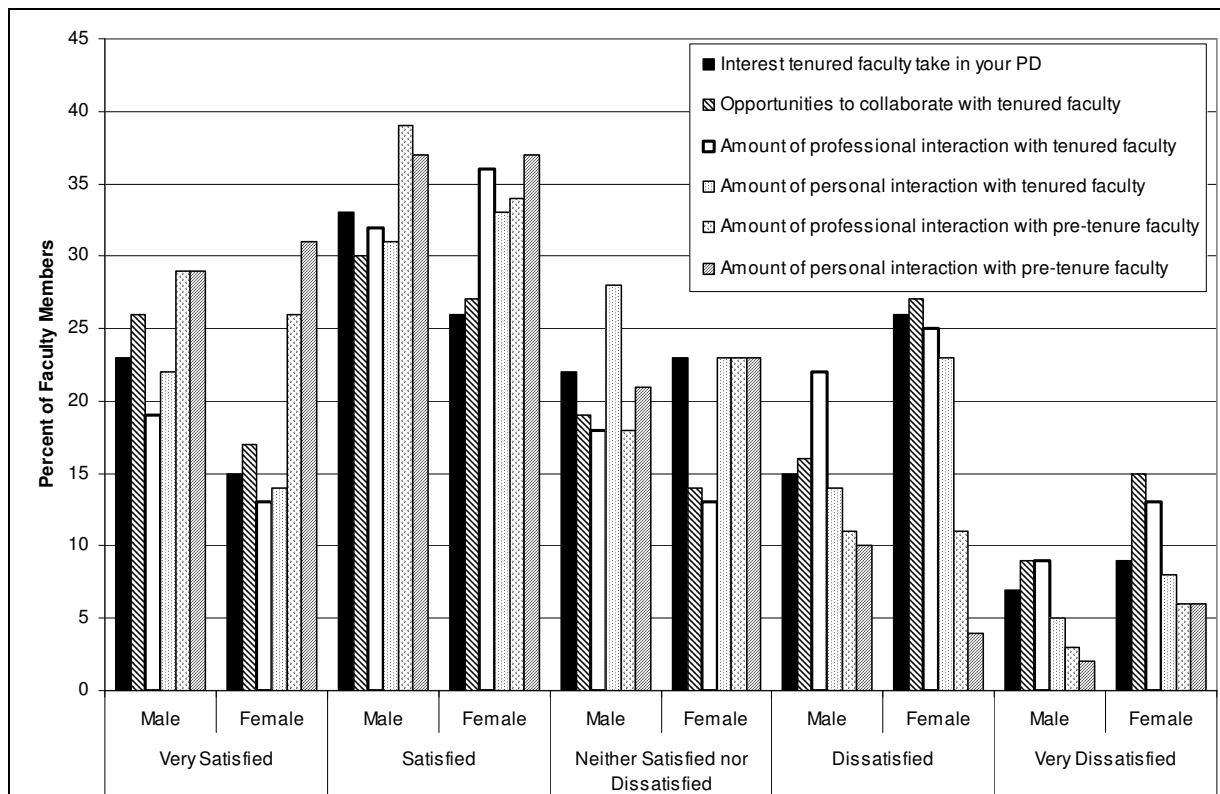
The interview data illuminated many topics regarding interactions and relationships in

addition to the topics covered in the survey. The next section details topics that were extensively

discussed during the interviews. First, experiences with leadership are discussed, followed by

experiences with collaboration, and the differing viewpoints of the three ranks of professors.

Differences about frequency and usefulness of interactions are also presented, followed by an

analysis of the initiation of interactions, and finally, the barriers to collaboration and interactions

are discussed.

Departmental Leadership

The interview data provided a description of how the faculty members perceived the

effectiveness of and their satisfaction with the leadership of their department. Most faculty

members reported that the department chair or head was the leader. Many faculty members also

described leadership from faculty members who hold the other named positions within the

department such as associate chair or graduate director, but at least one faculty member stated

that no one really stands out or has any power within their department other than the department

chair or head. Transparency, fairness and honesty in leadership were discussed by many faculty

members as positive qualities of the leadership in their department. Faculty members from two

institutions described either a lack of transparency or fairness in their leaders that has resulted in

distrust or conflict among the faculty members who believe there is an unequal distribution of

resources or assignments. Three institutions represented in the interview sample had a female

chairperson or department head. At least one male faculty member from two of those institutions

described a lack of leadership from the Dean down to the chairperson or department head that

was causing conflict within the department. One of the male full professors described his

department head as "a nice enough lady…I personally like her, but I don't think she is a very

effective leader, but he [the Dean] chose her because he wanted to have a woman" (MP5, line

163). Under Acker's theory of gendered organizations (Acker, 1990), this alleged hiring of a

female for the sake of having a female in the role of department head would be considered an

attempt to re-construct the traditional image of a male in the position of mechanical engineering

department head; but this particular female department head is not imagined as having

"successful, forceful masculinity" (Acker, 1990, p. 146) and therefore the faculty members in the

department do not view her with the same respect that the previous male department head received.

<center>*A Culture for Collaboration*</center>

In terms of collaboration, there seemed to be a disconnect between the recollections of the full professors with the actual experiences and perceptions of the assistant and associate professors involved in the study. As discussed earlier in this chapter, many full professors noted that their institution had shifted in the policy toward collaborative research since the time that their faculty appointment began. Advice that the full professors received when they took their first faculty position suggested that they should only do research and publish papers with their own graduate students, and that collaboration was frowned upon. This advice was not specific to faculty members of either gender, as one female professor noted that she received, "the very sincere advice that I think was given to everybody at that time about don't, you know be really careful and you need to be sure that you prove yourself" (FP8, line 111). A male professor suggested the following rationale for similar advice he received when he first started,

> There still was a very prevalent attitude that you know if you collaborate with others the
>
> problem is that when you go up for tenure there will be difficulty evaluating your
>
> contribution versus other people's contributions. It was sort of looked down upon to do
>
> collaborations….I'd say that within mechanical engineering in particular, there has been
>
> a huge change in attitude towards um, collaborative research, partly, I think, spurred on at
>
> least by National Science Foundation which was pushing for these collaborations. (MP5,
>
> line 88)

Data from the interviews illuminated the fact that of the full professors, only two males explained that the bulk of the research work they do is collaborative, and the caveat for one of

them was that he is often engaged by other faculty members to collaborate; he does not like to

write proposals or come up with the big ideas, but he does contribute his knowledge and skills.

The other professor felt that the collaborations he engaged in were much more of a two-way

interaction with work and initiation of interactions coming from both parties. Though the

perceptions of the full professors were that the culture with Mechanical Engineering departments

has changed to allow for more collaborative work, it was not clear that any of the other full

professors interviewed in this study actively sought out collaborators within their institution

related to their research work. It was also not apparent in most cases that the institutional

support of collaborations led to increased or more productive interactions with colleagues. In

fact, many faculty members reported the contrary.   Three female faculty members noted that

they are more actively involved in collaborations with faculty members in other departments or

at other institutions, and that there is a lack of research-focused conversations happening within

their institutions, or if these conversations are happening they are not involved in them. Only

one male faculty member described a similar environment for communication, and he surmised

that "the value placed on that kind of you know intellectual discussion, free-ranging intellectual

discussion doesn't have any infrastructure support or cultural support" (MP8, line 221) at his

institution. Male faculty members who are employed at the same institutions as the females who

reported lack of research-focused conversations expressed the opposite in their interviews. One

male professor believed that,

> The idea of collaboration here is very much ingrained in the culture and that has been
>
> very helpful and advantageous that you don't get at a lot of institutions. I've visited other
>
> institutions and junior faculty have a very collegial um, relationship with their faculty

> colleagues, but they don't collaborate, they don't talk about research, they are
>
> competitors in every sense of the way. (MP7, line 231)

This professor highlighted the difference in actual collaboration between his institution and others, but his perceptions still disagree with the perceptions of his female colleagues. Acker describes this as "gendered social structures" (1990, p. 146) whereby males or females may be included or excluded in different topics of conversation based on their sex. In the case of these faculty members' experiences, they were apparently excluded from research conversations and collaborations with their departmental colleagues, but had ample opportunity to engage in these types of discussions with individuals from other departments and/or institutions. To further describe issues with respect to communication, one female associate professor described feeling a "personal disappointment with some of the quality of the interactions. I think that, you know, people just aren't—at the end of the day, being as innovative as I think they could be" (FC5, line 142). Another female associate professor wished for more productive interactions, and one female assistant professor felt similarly, though she referenced this in terms of a lack "of aggression to go after grants and big research problems" (FT1, line 162), where she had this drive to be research intensive in her environment. Of note with respect to this assistant professor, she completed her PhD and post-doctoral work at RU/VH institutions and is employed at a DRU [DRU are defined as Doctoral/Research Universities. This includes institutions that awarded at least 20 research doctoral degrees during the update year (excluding doctoral-level degrees that qualify recipients for entry into professional practice, such as the JD, MD, PharmD, DPT, etc.). (http://classifications.carnegiefoundation.org/descriptions/basic.php)] institution. So the different classification of her current institution could explain some of her colleagues' lack of aggression.

Initiation of Collaborations and Interactions

In terms of initiation of collaborations and interactions, faculty members differed based on both gender and rank in how their perceptions. Assistant professors were the group who most often described a lack of reaching out by colleagues for collaboration, and while this was predominantly the case for female faculty, two male assistant professors also felt similarly. If collaborations with senior colleagues took place, it tended to be because the assistant professor initiated the interaction. The survey data showed similar results, where less than half of female faculty members reported feeling satisfied or very satisfied with both the opportunities to collaborate with tenured faculty and with the amount of professional interaction they had with tenured faculty. Interview data also illustrated that initiation of interactions did not come easily to the female professors. In fact, one female assistant professor felt very strongly about her inability to reach out to male faculty members for collaborations when she said,

> Most of the time you're isolated because it, of course it doesn't look good to knock on the door of your colleagues and every time you go by and have discussion [sic] so that's a, that's kind of a disadvantage. And uh, yeah I think that's kind of natural lack of interest between men and women, like most of my male colleagues don't—never stop to ask me how I'm doing or how it's going. It's only female colleagues that care to ask these kind of questions. And that makes an impact. (FT3a, line 333)

It is important to note here that this assistant professor is not from the U.S., but the premise of her argument that male colleagues do not reach out to her made enough of an effect that she discussed it in the interview. This interaction scheme results in "patterns that enact dominance and submission" (Acker, 1990, p. 147) among departmental colleagues and resulting in gendered communication and interactions where female faculty members' perceive that they should

submit to a lack of acknowledgement by colleagues. In contrast, at least one male assistant

professor described his appreciation that "whenever there's any opportunity to bring me in, the

senior faculty can do the initiating" (MT7a, line 173) so that he does not have to initiate the

interaction. Overall, female tenure-track faculty members more often expressed an interest in

having a higher number of collaborations with senior faculty members, while male tenure-track

faculty members more often described being satisfied with the quantity and quality of

collaborations they have with senior faculty colleagues.

<div align="center">*Barriers to Collaborations and Interactions*</div>

In terms of barriers to collaborations and interactions, faculty members of both genders

weighed in with multiple examples and frustrations. Many felt that if you can't work

independently you aren't going to succeed on the tenure track. One female assistant professor

felt strongly about this issue stating, "you know if I have an innovative idea and if I can carry it

out by myself, then nobody's stopping you. You can always do it. But if you need other people's

help in order to develop this idea then, you know it really depends" (FT3, lines 342-345). A

female full professor expressed that "the intellectual sharing of ideas is so stimulating but

happens so infrequently" and that she really feels like "right now it's a very individual

gratification job, and I think I would like it better if it was more collaborative with other

researchers" (FP7, lines 422-423). Others felt similarly and spoke about having to go out of their

way to talk to colleagues and not having the flexibility to engage in informal discussions about

potential research collaborations. One female assistant professor who was dismayed by this

explained, "you have to make an appointment with them….You, you really have to have a very

specific objective before you set up that appointment…it just seems really formal. I don't think

it should be that way" (FT3, lines 168-171). Overall, male professors were much more likely to

describe casual, drop-in discussions about research topics. The difference in types of communication described by the male and female faculty members again reiterate the patterns of male dominance of conversation style and topic and female submission to the flow of the discussion as a process that produces "gendered social structures" (Acker, 1990, p. 146).

Summary of Relationships and Interactions

In summary, the data showed that male and female faculty members differ with respect to their perceptions regarding interactions among their professional colleagues. Females tended to be more dissatisfied with the frequency and quality of their interactions, especially interactions with senior colleagues. In addition, there is clear evidence that the interactions that occur produced gendered social structures for how conversation should occur in a department, where male faculty members tended to be more communicative with other male faculty members while leaving the female faculty members to find alternative interactions.

Summary

This chapter presented the first half of the data analysis to better understand how female mechanical engineering faculty member experiences in academia affect their career satisfaction. The research questions addressed in this chapter pertained to perceptions of departmental climate based on faculty member academic rank and differences in levels of satisfaction with respect to the nature of work based on faculty member gender. Data analysis presented in this chapter included descriptions of the survey data using frequency tables by academic rank and gender, calculations of chi square statistics to determine differences between faculty members by either academic rank or gender, and use of qualitative interview data to support and refine the quantitative analysis.

In terms of perceptions of departmental climate, faculty members views varied based on academic rank. Assistant professors believed their departments were collegial and tended to perceive departmental climate based on their ability to collaborate and the amount of support and informal interaction they have with colleagues. Associate professors were much less likely to describe their department as collegial and more frequently described it as competitive. Full professors described how their department had changed to become more positive since they had begun their appointments. Overall, a majority of faculty members of all ranks describe their departments as collegial, with a minority of associate and full professors describing their departments as individualistic.

With respect to the nature of work, reported levels of satisfaction were consistent between male and female faculty members in many areas. Levels of satisfaction were inconsistent with respect to time spent on research and research-related activities. Overall, high percentages of faculty members were satisfied with their influence over the focus of their research, and three areas related to teaching: the discretion over the content of courses taught, the level of courses taught, and the degree of influence over courses taught. However, there were also four areas where much higher percentages of female faculty members than male faculty members were dissatisfied with aspects of their work: the amount of time they have to conduct research, the amount of external funding expected, the number of hours worked, and the way they spend their work time.

With respect to level of satisfaction with the nature of work, faculty members perceptions differ by gender. In terms of departmental leadership, transparency, fairness and honesty were discussed by many faculty members as positive qualities of effective leadership. Female faculty members tended to be more dissatisfied with the frequency and quality of their interactions with

colleagues, particularly interactions with senior colleagues, whereas male faculty members tended to be more communicative and open to collaboration with other males. There was a disconnect between the experiences and perceptions of the assistant and associate professors in terms of collaboration when compared to the perceptions of the full professors. Full professors felt that the culture and climate for collaboration within their department was much better than when they first joined the department, however they did not seek out collaborative work with colleagues. Overall, differences exist in the perceptions of male and female faculty members with respect to the nature of their work.

CHAPTER V: FINDINGS PART II: RESOURCES, POLICIES/PROCEDURES AND

SATISFACTION IN ACADEMIA

Introduction

The purpose of this mixed-methods study is to better understand how female mechanical

engineering faculty member's experiences in academia affect their career satisfaction. This

chapter presents the data analysis related to the following three research questions:

1. How do perceptions of resource allocations compare for male and female mechanical

    engineering faculty members?

2. How is job satisfaction related to perceptions of departmental policies/practices?

3. How do male and female mechanical engineering faculty members compare with regard

    to their employment satisfaction in academia?

More specifically, this chapter details the analyses of both the quantitative and qualitative data

related to faculty members' perceptions of the fairness of how resources are allocated, how

departmental polices/practices affect their career satisfaction, and their overall level of

satisfaction with employment in academia. This chapter reports on the trends in the data

collected from mechanical engineering faculty members that could be useful for policy makers

while also chronicling the experiences of individual mechanical engineering faculty members to

add greater understanding from the perspective of individuals embedded within this higher

education context. The analysis of survey data is presented first, followed by the qualitative

analysis that builds on and refines the quantitative analysis. This chapter begins with a

presentation of faculty members' perceptions about resource allocation to answer the first

research question noted above, followed by faculty members' reported satisfaction with

policies/procedures to answer the second research question noted above, and finally faculty

members' reported satisfaction with employment in academia to answer the final research question.

Perceptions of Resource Allocations

Analysis of mechanical engineering faculty members' perceptions of resource allocations began with an examination of a subset of five survey questions that fall under the "The Nature of Your Work" section of the COACHE survey and continued with analysis of the interview data associated primarily with questions 11 through 13 of the interview protocol, which are restated below:

- How is space allocated in your department? Who has the "prime" real estate?

- What resources do you need to be successful as a mechanical engineering faculty member, but don't currently have access to?

- What types of resources do you have available to you as a mechanical engineering faculty member that have helped make you successful? Are these resources typically available to all faculty members?

As noted on the survey, the items analyzed in this section explore the quality of support services that are necessary for a faculty member's day-to-day work. The open-ended interview questions that probed this topic focused broadly on the resources that faculty members deem necessary for their day-to-day teaching and research work. Of interest in this study was how resources are allocated and whether perceptions of resource allocations differ based on sex, so the descriptive statistics based on the survey data that are displayed in Table 14 are shown by percentages of female and male faculty members. The number of faculty members who responded to each of these survey questions varied, so the total sample size responding to each survey question is included for reference. The set of survey questions analyzed in this section had five response

categories, including: very satisfied, satisfied, neither satisfied nor dissatisfied, dissatisfied, and very dissatisfied. A 2 x 5 chi-square was computed comparing the level of satisfaction with each of the survey items related to quality of support services among male and female faculty members. It was found that significantly more female faculty members report dissatisfaction with the amount of access to Teaching Fellows, Graduate Assistants, et al., than male faculty members ($\chi^2(4) = 12.865$, p<.05). The chi squares for the other four survey questions were found not to be significant and are included in Table 14. More than 50% of faculty members reported being "dissatisfied" or "very dissatisfied" with two of the survey items: amount of access to Teaching Fellows, Graduate Assistants, et al.; and, quality of research services, as denoted in boldface text in Table 14 and graphically displayed in Figure 11. In fact, only about one-third (35%) of female faculty members are satisfied with the quality of research services in contrast with almost one- half (49%) of male faculty members who reported being satisfied with these services. With respect to amount of access to Teaching Fellows, Graduate Assistants, et al., more than half (52%) of female faculty members are dissatisfied with the amount of access they have, a much larger percentage than that of male faculty members who report being dissatisfied at a rate of 28%. Faculty members of both sexes report the highest levels of satisfaction with respect to the quality of clerical/administrative services, teaching services, and computing services, with an average of 60% of faculty members of both sexes reporting satisfaction with these three services.

Table 14. Percentage of male and female faculty members who are satisfied with the support services

	χ^2 (df, N)	Very Satisfied (Male / Female)	Satisfied (Male / Female)	Neither Satisfied Nor Dissatisfied (Male / Female)	Dissatisfied (Male / Female)	Very Dissatisfied (Male / Female)
The amount of access you have to Teaching Fellows, Graduate Assistants, et al.	12.865, *p = .012 (4, *N* = 230)	12 / 10	35 / 25	25 / 14	**18 / 40**	10 / 12
The quality of clerical/administrative services.	8.037, p = .090 (4, *N* = 237)	22 / 26	37 / 32	17 / 11	**19 / 13**	6 / 17
The quality of research services.	6.532, p = .163 (4, *N* = 235)	15 / 9	34 / 26	22 / 38	20 / 15	9 / 12
The quality of teaching services.	1.668, p = .797 (4, *N* = 231)	17 / 15	44 / 38	26 / 29	7 / 12	6 / 6
The quality of computing services.	1.476, p = .831 (4, *N* = 231)	20 / 19	40 / 46	25 / 19	12 / 10	4 / 6

Note. *p<.05, **p<.01, ***p<.001

Figure 11. Levels of satisfaction with support services by percentage of male and female faculty members
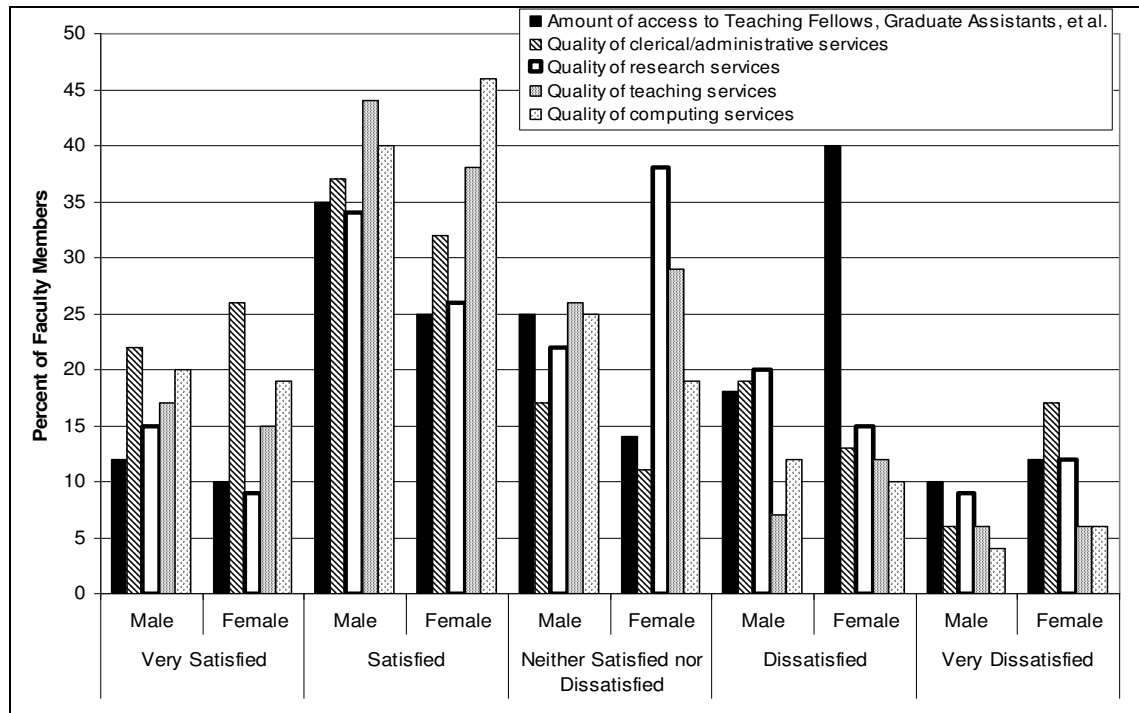
Analysis of interview data regarding the allocation of resources revealed similar results as the survey data. Faculty members from four different institutions identified the struggle to attract good graduate students as a major challenge. For some, they deemed this a result of the institution's inability to attract "high caliber" (FT1, line 213) graduate students because of a lack of recruiting, or in some cases because the institution is not a high or very high research intensive university. Male faculty members were much more likely to describe having a good group of graduate students who do research, as evidenced by MP3a's comment when he described his students as, "a pretty good group of graduate students…many of them are very, very high quality….I mean ultimately, if you don't have good students you really can't do anything" (MP3a, lines 174-176). He recognized that as a faculty member he requires the resource of good students in order to further his research agenda. In contrast to the survey data displayed above, faculty members of both sexes described having good teaching assistants to assist with the grading for courses, and no female faculty members specifically expressed dissatisfaction with teaching assistants, though they did express dissatisfaction with access to adequately trained graduate assistants to do research as evidenced by two females when they stated explained their experiences as, "a struggle attracting good graduate students" (FC5, line 338) and challenging because "I don't think we attract a high caliber student" (FT1, line 213).

Quality of Support Services

With respect to quality of support services, opinions varied widely among the faculty members who were interviewed, and the findings mirrored the survey results. With regard to research support, faculty members from many institutions reported having no access to pre- or post-award support for writing, submitting, or administering grants. Female faculty members were much more likely to describe a need for additional resources related to research support;

only two male faculty members suggested that they could use additional help in preparing, submitting, and administering grants and research proposals. Two of the female full professors who also serve as department heads described an increase in the departmental or college-level support for research proposal preparation and administration since they became department head. One of the full professors said, "it's hard to get the faculty to make use of it [research support infrastructure] because they're not used to having it," (FP10, line 218) but her colleagues reported having no knowledge of any departmental or college-level support for preparation of budgets for proposals or administration of grants post-award suggesting an apparent lack of communication within the department. With regard to the quality of support for teaching, only one faculty member mentioned the need for increased support for training in instructional techniques. Faculty members from four other institutions described a variety of teaching and learning centers on their campuses that they felt were valuable. The number of faculty members who discussed teaching support as a resource (or as a needed resource) was evenly split between males and females, and was mostly discussed by assistant professors. The overall lack of support or assistance with research activities that was mentioned by female faculty members in particular could be considered a gendered practice that serves to advantage faculty members who do not perceive a need for support, or who tend to work and solve problems independently (Acker, 1990). The female faculty members in this study more often expressed a need for additional resources and support related to their research activities; which was apparently not readily available for them. The image of a successful organization that has characteristics "such as strength, aggressiveness and competitiveness" (Acker, 1998, p. 445) seems to be in conflict with the needs expressed by these female faculty members. The expressed need for support by female faculty members could be seen as contrary to the generally held expectations of behavior

in these departments, i.e., independence or tendency to not ask for support. This could cause the female faculty members to "gender" their identity within their department to better match the expectations, or provide an argument for departments or institutions to consider moving toward "a more feminized version of authority…which seeks to engage and inspire rather than deliver ultimatums" (Maddock, 1999, p. 43), or in this example, not deliver needed resources.

In terms of the quality of computing support, the majority of faculty members who discussed the need for increased financial assistance to upgrade technology and a few faculty members described very good computing facilities throughout their engineering college or school. There were no differences by sex in the ways that faculty members perceived the quality of computing support.

Equity of Space Allocation

With respect to policies for allocating space and making departmental decisions in general, many faculty members referenced the importance of transparency in how these decisions are made. In some cases the issue of transparency was raised because the faculty members stated that the way decisions were made was not apparent to anyone. Others raised this issue because there had been a shift toward increased transparency when a new department chair had started. Two female faculty members did not believe that there was any policy in place at their respective institutions for assigning research/office space but colleagues at their institutions were able to explain the processes that were in place. A male full professor employed at one institution reported that research-active faculty members get two labs and "in circumstances where you're doing really well, and if your research is aligned with the areas that they want to push, like nanotechnology, biotechnology, energy, then they would be willing to even give you three labs" (MP3a, lines 240-242). In contrast a female assistant professor from this same

university who expressed her frustration in obtaining adequate lab space and had even began to set up her lab, only to find out it had been reassigned. She noted,

> [It's] not my ideal lab space, but at this time it's working, so that's, that part is kind of frustrating because a lot of things are not really under the department's control. Like lab space, it belongs to the…university, it belongs to the school of engineering so even if I did talk to, you know my department head, he's not able to help, he doesn't even know what's going on because the lab space doesn't belong to the department.…Like my lab, it takes awhile to set my lab up…and this summer they, um, somehow assigned my lab to someone else, without me knowing it. And then one day I just found everything was gone. All my stuff is gone, like they just took it. (FT3, lines 22-37)

The lack of transparency in allocating space has been a significant frustration for this female assistant professor and has negatively impacted the amount of research she has been able to produce during her time at the university. Equity and transparency with how space was allocated was a theme that was mentioned by other professors interviewed; one female associate professor expressed her dissatisfaction with how her space was assigned:

> It's when you come in what's available. Just sort of whatever's easiest is what you get and there is almost a sort of randomness to it. And then once you sort of get locked into that you need bigger space because, you know you've been there for five years and now you've got ten projects running there's not really an option to expand, there's not really a way to discuss and say, ok, I need to put my name in to be considered for more space or something….And so like I said they're building a new building because we're moving the whole department and it's sort of the ideal time to *have* that discussion and instead it was sort of divided up evenly, because I think it was the easiest solution. Um, and so for

me being an experimentalist and having several things going, and you know, basically

breaking every safety rule in the lab because I've got things stacked on top of each other

that's a big issue. (FC2, lines 255-267)

The male full professor at this institution fully believed that the way space was assigned was

transparent and fair. He said that when they were allocating space in the new building, "we just

walked around the rooms with the map and everybody picked and we all agreed at first at the

faculty meeting to do it that way" (MP2, line 217). He continued by explaining that the,

Labs are basically the same size, so we structured it so that it would be fixed so it would

be easy to be fair basically…we'd rather do that and have everything transparent and if

anybody has a question [they can ask]; you know transparency is um, worth the effort.

It's actually less effort in the long run. (MP2, line 232)

This is another example giving evidence of a breakdown of communication among the faculty

members at this university which has lead to feelings of inequity and a belief that there is opaque

decision making by the leadership. In general, the rest of the faculty members described being

able to work adequately with the space they were assigned or that they had negotiated when they

began their appointment and many faculty members suggested that space could be reassigned or

made available if they required more. In some instances it is possible that the communication

breakdown was a result of imperceptible male networks within a department. Kantola (2008)

suggested that males in academic departments interact in a network "where tacit knowledge [is]

transmitted" (p. 220) and females are not privy to that knowledge. Acker (2006) suggests that

practices of gendered interaction such as those described above (limited communication or

limited information transfer between males and females) "re-create gender…inequalities [and]

are often subtle and unspoken" (p. 451) thus making it difficult to both document and adjust behavior.

Summary of Perceptions of Resource Allocations

Perceptions of resource allocations did not vary much based on sex of faculty member. Similar percentages of male and female faculty members were satisfied with the quality of clerical/administrative, teaching, and computing services and this satisfaction was consistent with the interview data. A smaller percentage of female faculty members were satisfied with the quality of research services and significantly more female faculty members report dissatisfaction with the amount of access to Teaching Fellows, Graduate Assistants, et al., than male faculty members. Female interviewees were much more likely than male interviewees to describe a need for additional resources related to research support. Faculty members of both sexes expressed difficulty in attracting good graduate students for research support. Perceptions of equity in allocating space in the department varied by the sex of the faculty member, with female faculty members reporting less transparency, fairness, and equity in assignment of space. To summarize, faculty members' perceptions of resource allocations with respect to resources related to research differed by sex, but perceptions of resource allocations with respect to other resources did not vary widely among the faculty members in this study. Formal policies with regard to resource allocation were looked on favorably by faculty members when they were in place, and were sought by faculty members who did not believe they were in place.

Perceptions of Departmental Policies/Practices

This section presents the data collected from the mechanical engineering faculty members concerning their perceptions of the importance and effectiveness of departmental policies/procedures and their satisfaction with these policies/procedures. This analysis serves to

answer the second research question, "how is job satisfaction related to perceptions of

departmental policies/practices?" Analysis began with an examination of a subset of sixteen

survey questions that fall under the "Policies and Procedures" section of the COACHE survey

and continued with analysis of the some of the interview data discussed earlier in this chapter

and associated primarily with questions 12 through 13 of the interview protocol, which were:

- What resources do you need to be successful as a mechanical engineering faculty

  member, but don't currently have access to?

- What types of resources do you have available to you as a mechanical engineering faculty

  member that have helped make you successful? Are these resources typically available to

  all faculty members?

As noted on the survey, the items analyzed in this section address faculty policies and practices

common at colleges and universities. The survey specified that faculty members should respond

to each policy/practice regardless of whether it currently applies to their institution. Respondents

were asked to rate the importance of the policy/practice to their success and the how effective the

policy/practice has been at their institution. The survey questions related to importance of the

policy/practice to faculty member's success had five response categories: very important,

important, neither important nor unimportant, unimportant, and very unimportant. The survey

questions related to how effective the policy/practice has been at the institution had seven

response categories: very effective, effective, neither effective nor ineffective, ineffective, very

ineffective, not offered at my institution, and I don't know/not applicable. Of interest in this

study was how perceptions of importance and effectiveness of policies/practices differ based on

sex, therefore, the descriptive statistics based on the survey data that are displayed in Tables 15

and 16 are displayed by percentages of female and male faculty members. The number of

faculty members who responded to each of these survey questions varied, so the total sample size responding to each survey question is included for reference. At least sixty percent of female faculty members rated the 16 policies/practices as important to their success, with the exception of financial assistance with housing, which was only rated "important" or "very important" by 31% of female faculty members. Male faculty members felt that the 16 policies/practices were similarly important, with the exception of the following four policies/practices (percentage of males who rated the policy/practice as important in parentheses): paid or unpaid personal leave during the pre-tenure period (44%), childcare (55%), financial assistance with housing (36%), and spousal/partner hiring program (56%). As indicated in Table 15, there are four policies/practices that were rated as important by female faculty members at a rate at least ten percent higher than male faculty members: formal mentoring program for junior faculty; paid or unpaid research leave during the pre-tenure period; paid or unpaid personal leave during the pre-tenure period; an upper limit on committee assignments for tenure-track faculty; and, childcare (shown in bold typeface in Table 15). In all cases with the exception of financial assistance with housing, a higher percentage of male faculty members rated these policies/practices as unimportant to their career success. As displayed in Figures 12 and 13, female faculty members rated the set of policies/procedures as "very important" much more often than male faculty members, with eleven of the policies/practices rated "very important" by 40% or more of female faculty members, and only two policies/practices rated "very important" by 40% of male faculty members. Further analysis of the survey data by faculty member academic rank showed that assistant and associate professors rated as "important" or "very important" policies/practices related to formal mentoring (75 and 63%, respectively vs. 42% of full professors) and informal mentoring (87 and 89%, respectively vs. 75% of full professors) more frequently than did full

professors. Four policies/practices had the highest percentage of male faculty members who rated them as unimportant to their success, with more than 15% of male faculty members choosing that rating, as follows (percentage in parentheses): formal mentoring program for junior faculty (15%), childcare (22%), financial assistance with housing (27%), and spousal/partner hiring program (23%). Female faculty members rated the last two of those policies/practices as unimportant to their success at a similar rate as the male faculty members, with financial assistance with housing and spousal/partner hiring program being rated as unimportant by female faculty members at a rate of 40 and 23 percent, respectively. The most important policy/practice rated by male faculty members as having an effect on their success is an upper limit on teaching obligations, where 96% of males reported this as an important policy. Two policies/practices tied for most important for the female faculty members, with informal mentoring and an upper limit on teaching obligations both reported by 96% of the female faculty members as important to their success. These findings support those of the COACHE researchers, who reported that the policy/practice that was the most important to the success of faculty members was an upper limit on teaching was and the policy/practice that was the least important to their success was financial assistance with housing (COACHE, 2007).

A 2 x 5 chi square was computed comparing the level of importance with each of the survey items related to policies/practices among male and female faculty members. It was found that significantly more female faculty members reported nine policies/practices as "important" compared to the male faculty members [significant items identified in Table 15]. It is important to note that with respect to the policy/procedure of an upper limit on teaching obligations, 70% of female faculty members rated this policy/procedure as "very important" compared to 50% of

male faculty members, as shown in Figures 12 and 13. The chi square statistics for the other

seven survey questions were found not to be significant.

Table 15. Importance of policies/practices by sex of faculty member (in percentages)

	χ^2 (df, N)	Very Important (Male / Female)	Important (Male / Female)	Neither Important nor Unimportant (Male / Female)	Unimportant (Male / Female)	Very Unimportant (Male / Female)
Formal mentoring program for junior faculty	10.485, *p = .033 (4, N = 237)	21 / **40**	47 / 45	17 / 9	13 / 6	2 / 0
Informal mentoring	15.060, **p = .005 (4, N = 237)	36 / **64**	48 / 32	9 / 2	4 / 2	3 / 0
Periodic, formal performance reviews for junior faculty	16.135, **p = .003 (4, N = 237)	27 / **55**	57 / 36	8 / 8	7 / 2	2 / 0
Written summary of periodic performance reviews for junior faculty	14.162,** p = .007 (4, N = 236)	22 / **46**	59 / 39	12 / 14	5 / 2	2 / 0
Professional assistance in obtaining externally funded grants	6.265, p = .099 (4, N = 237)	40 / 53	44 / 30	12 / 8	4 / 9	0 / 0
Professional assistance for improving teaching	1.353, p = .852 (4, N = 236)	14 / 17	51 / 51	24 / 21	10 / 11	2 / 0
Travel funds to present papers or conduct research	7.449, p = .114 (4, N = 235)	38 / **58**	44 / 33	11 / 8	6 / 2	1 / 0
Paid or unpaid *research* leave during the pre-tenure period	8.370, p = .079 (4, N = 234)	21 / **37**	43 / 40	24 / 21	9 / 2	3 / 0
Paid or unpaid *personal* leave during the pre-tenure period	21.217, ***p = .000 (4, N = 233)	10 / **32**	28 / 32	44 / 25	11 / 11	7 / 0
An upper limit on committee assignments for tenure-track faculty	12.924, *p = .012 (4, N = 236)	24 / **47**	51 /38	20 / 15	5 / 0	1 / 0
An upper limit on teaching obligations	6.682, *p = .035 (4, N = 237)	50 / **70**	46 / 26	4 / 4	0 / 0	0 / 0
Peer reviews of teaching or research/creative work	5.910, p = .206 (4, N = 236)	20 / 34	55 / 49	18 / 9	7 / 8	1 / 0
Childcare	27.064, ***p = .000 (4, N = 231)	21 / **58**	34 / 17	12 / 17	11 / 8	12 / 6
Financial assistance with housing	4.348, p = .361 (4, N = 232)	11 / 6	25 / 25	37 / 29	16 / 21	12 / 19

Stop-the-clock for parental or other family reasons	31.086, ***p = .000 (4, *N* = 229)	19 / **59**	48 / 23	19 / 9	7 / 6	6 / 4
Spousal/partner hiring program	8.002, p = .092 (4, *N* = 234)	25 / 42	32 / 19	21 / 15	10 / 14	13 / 10

Note. *p<.05, **p<.01, ***p<.001

Figure 12. Level of importance of policies/practices by percentage of female faculty members
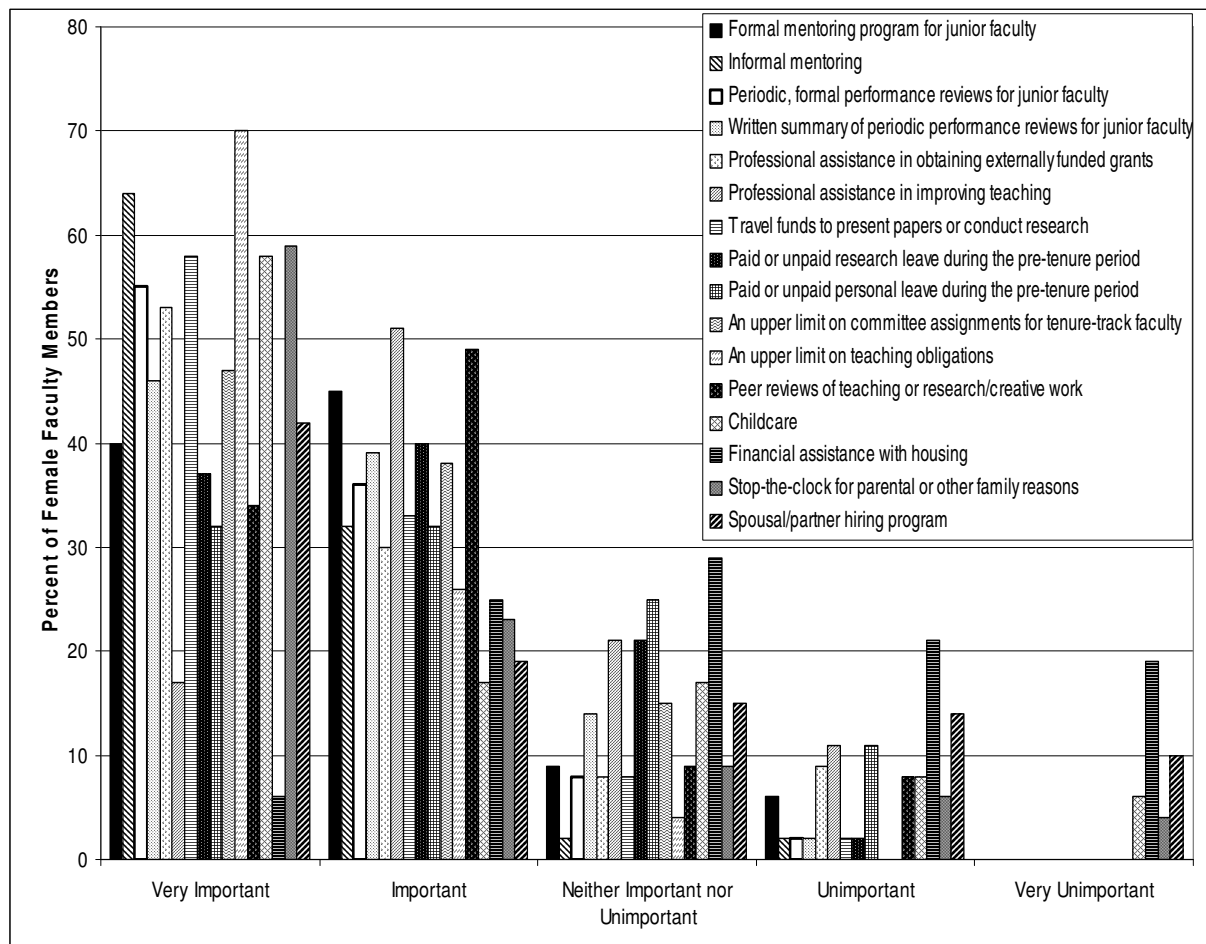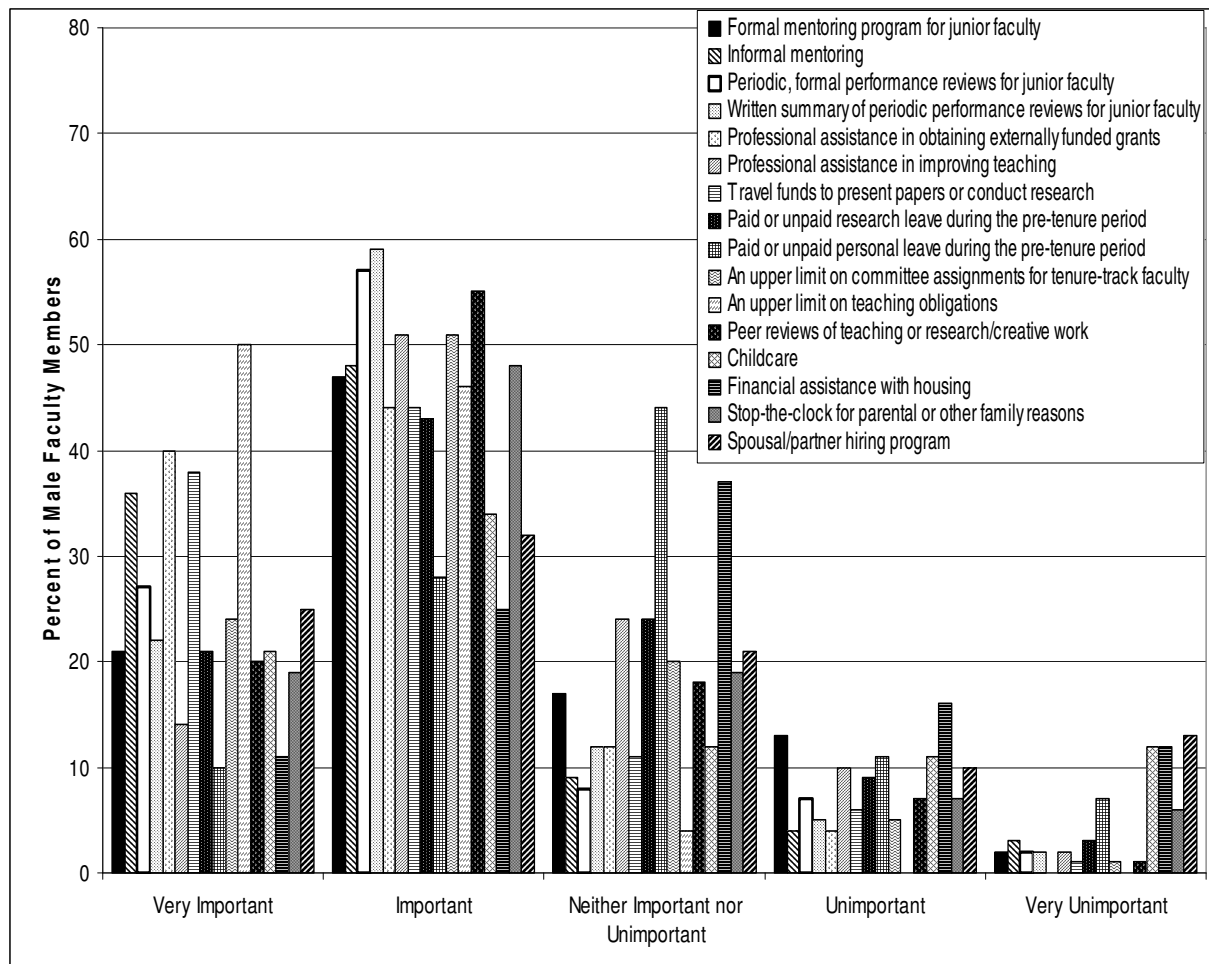
Figure 13. Level of importance of policies/practices by percentage of male faculty members

The data with respect to effectiveness of policies was much less clear since a large percentage of faculty members of both sexes reported that many of the policies/practices were not offered at their institution, or they did not know about the effectiveness of the policy/program. After considering Table 16, it should be noted that female faculty members report eleven policies/procedures "effective" or "very effective" at their institution at a higher rate than male faculty members. Informal mentoring was reported as the most effective policy by female faculty members and an upper limit on teaching was reported as the most effective policy by male faculty members. Three of the sixteen policies/procedures were rated "effective" or "very effective" at a rate of at least 20% more female faculty members than male faculty

members: informal mentoring (70% of females vs. 57% of males), paid or unpaid personal leave during the pre-tenure period (35% of females vs. 13% of males), and stop-the-clock for parental or other family reasons (50% of females vs. 20% of males). As can be seen in Figures 15 and 16, no policy/practice was rated as "very effective" by more than 30% of female faculty members or more than 20% of male faculty members.   Further analysis of the survey data by faculty member rank showed that associate and full professors rated policies related to formal mentoring (41 and 58%, respectively vs. 22% of assistant professors) and informal mentoring (70 and 75%, respectively vs. 58% of assistant professors) as being effective much more frequently than did assistant professors. The policies/procedures that the highest percentage of female faculty members found to be ineffective were: professional assistance in obtaining externally funded grants (49%); peer reviews of teaching or research/creative work (28%); spousal/partner hiring program (25%); formal mentoring program for junior faculty (23%); and childcare (23%). Male faculty members agreed with their female counterparts in citing the most ineffective policy/procedure that females reported at a rate of 33%, but differed in rating the subsequently least effective policies/procedures as follows: travel funds to present papers or conduct research (27%); formal mentoring program for junior faculty (26%); and, peer reviews of teaching or research/creative work (23%). These findings support those of the COACHE researchers, who reported that the policy/practice that was the most ineffective was professional assistance in obtaining externally funded grants and the policy/practice that was the most effective as reported by male faculty members was informal mentoring and by female faculty members was paid or unpaid research leave (COACHE, 2007).

Table 16. Effectiveness of policies/practices by sex of faculty member (in percentages)

	$\chi2$ (df, N)	Very Effective (Male / Female)	Effective (Male / Female)	Neither Effective nor Ineffective (Male / Female)	Ineffective (Male / Female)	Very Ineffective (Male / Female)	Not offered at my institution/ I don't know/ NA
Formal mentoring program for junior faculty.	7.733, p = .258 (6, N = 237)	10 / 4	23 / 36	23 / 13	14 / 15	12 / 8	18 / 24
Informal mentoring	5.254, p = .512 (6, N = 237)	17 / 21	41 / 49	20 / 11	8 / 9	7 / 8	8 / 2
Periodic, formal performance reviews for junior faculty	2.409, p = .879 (6, N = 237)	13 / 19	44 / 42	19 / 20	15 / 11	7 / 6	3 / 4
Written summary of periodic performance reviews for junior faculty	7.980, p = .240 (6, N = 236)	10 / 21	41 / 29	22 / 17	10 / 15	7 / 6	9 / 11
Professional assistance in obtaining externally funded grants	7.292, p = .295 (6, N = 237)	3 / 6	21 / 13	29 / 19	18 / **25**	15 / **25**	15 / 13
Professional assistance for improving teaching	7.393, p = .286 (6, N = 236)	8 / 17	35 / 32	27 / 26	13 / 17	6 / 2	11 / 6
Travel funds to present papers or conduct research	7.466, p = .280 (6, N = 235)	9 / 15	**31** / 19	17 / 19	18 / 10	9 / 12	16 / 25
Paid or unpaid *research* leave during the pre-tenure period	9.907, p = .129 (6, N = 234)	4 / 12	12 / 10	24 / 20	4 / 4	10 / 2	45 / 54
Paid or unpaid *personal* leave during the pre-tenure period	19.265, **p = .004 (6, N = 233)	2 / 11	10 / **25**	28 / 19	3 / 2	8 / 2	48 / 42
An upper limit on committee assignments for tenure-track faculty	10.943, p = .090 (6, N = 236)	11 / 9	36 / 21	24 / 19	4 / 13	6 / 6	20 / 32
An upper limit on teaching obligations	9.853, p = .131 (6, N = 237)	17 / 25	**42** / 26	20 / 17	9 / 13	6 / 4	6 / 15
Peer reviews of teaching or research/creative work	2.899, p = .821 (4, N = 236)	5 / 2	27 / 32	23 / 17	14 / 17	10 / 11	22 / 21
Childcare	7.373, p = .288 (6, N = 231)	11 / 15	6 / 10	20 / 15	10 / 8	7 / 15	55 / 48
Financial assistance with housing	10.959, p = .090 (6, N = 232)	1 / **0**	6 / **0**	17 / 15	4 / 0	5 / 8	67 / 77
Stop-the-clock for parental or other family reasons	31.798, ***p = .000 (6, N = 230)	4 / **26**	16 / **25**	16 / 8	2 / 2	4 / 2	58 / 38
Spousal/partner hiring program	4.695, p = .583 (6, N = 235)	2 / 6	8 / 10	14 / 15	9 / 8	13 / 17	55 / 44

Note. *p<.05, **p<.01, ***p<.001

Figure 14. Level of effectiveness of policies/practices by percentage of female faculty members
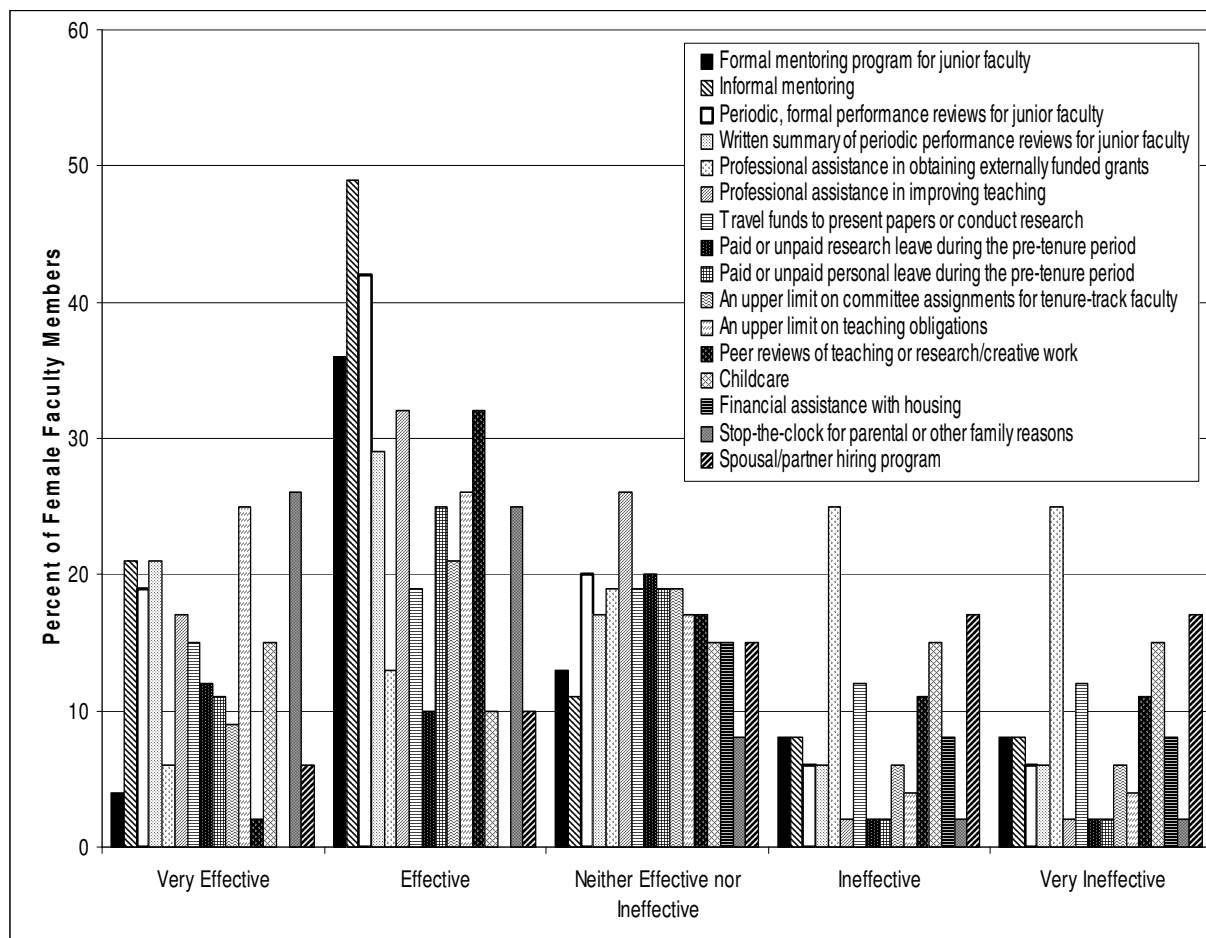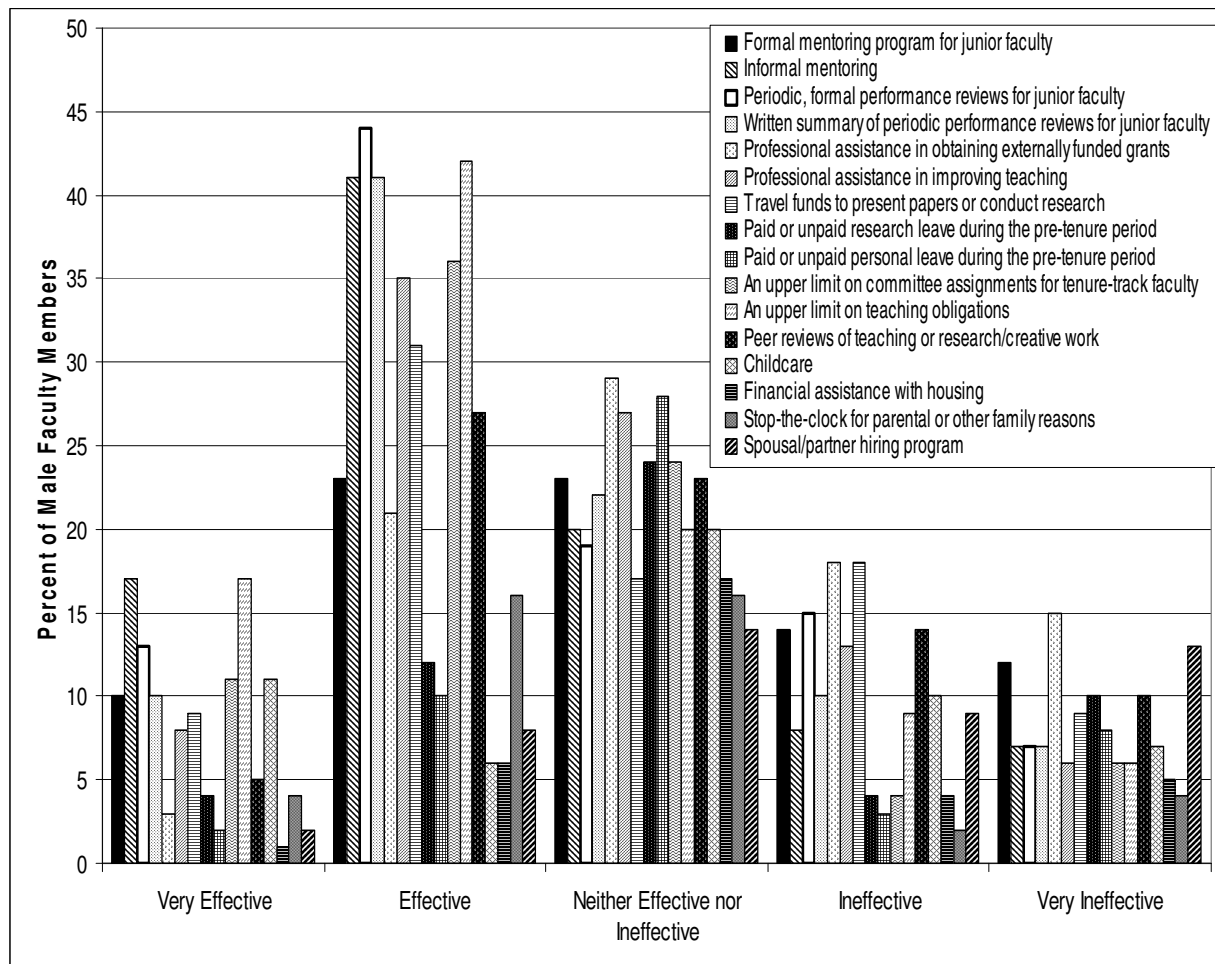
Figure 15. Level of effectiveness of policies/practices by percentage of male faculty members

Analysis of interview data regarding perceptions on the importance and effectiveness of policies/procedures revealed outcomes that were comparable to the survey results. This section discusses the topics of mentoring and childcare, the two topics where there was the widest discrepancies in the survey data among male and female faculty members and that have not been discussed previously. As noted in the survey data, high percentages of male and female faculty members reported the importance of policies/practices that set upper limits on teaching and committee assignments, and analysis of the interview data supported this finding. However, because these topics were discussed extensively in Chapter IV they will not be covered in the current chapter.

Faculty members at only four of the ten institutions represented in the interview sample described a formal mentoring program for tenure-track faculty members. Formal mentoring tended to be positive and effective if the mentor and mentee had similar research interests, had offices located close to one another, and got along well. Similar to the trend observed in the survey data regarding mentoring, only about one-third of female and male faculty members interviewed reported that formal mentoring at their institution was effective. One female assistant professor contrasted her experience with that of a male colleague as she expressed her disappointment with her formal mentoring experience:

> I have a colleague who was talking about his mentorship experience here…and his official mentor was close enough to his field that the senior professor could purposely include him on a grant. And so as a junior professor then, you know within the first couple of months of being here he saw this successful grant proposal put together, and he had his chunk of it that he got to contribute…I think that's a really powerful model for what a mentor can do. The mentors that I ended up with weren't, again, weren't closely enough aligned with my research that that's the type of thing that could happen. (FT7, lines 201-222)

This description highlights the importance of careful selection of mentors that fit with their mentees both in terms of research and collaboration interests. Assistant professors at three of the four universities who have participated in a formal mentoring program did not feel that the formal mentoring program was effective for them; they all referenced informal mentoring as having a more pronounced effect on their success. In fact, assistant professors often described informal mentoring with colleagues outside of their institution, in addition to colleagues within their institution as being effective and pivotal to their success. This analysis confirmed the

results of the survey which showed that both formal and informal mentoring are considered more important by assistant and associate professors than full professors, but are also seen as more ineffective by assistant professors, who are likely the most in need of mentoring. One male assistant professor highlighted the aspects of informal mentoring that were crucial to him as he stated,

> The key is mentoring. I mean that can not be understated how important that is. To have someone who you can bounce ideas off of, you can go to with a proposal say, hey can you look this over, you know, tell me what I'm missing. Because you know you're just learning how to do these things. And even teaching aspects you know, to try to figure out what is the best way of handling certain situations when they came up. I certainly didn't have a mentor for the first five years or first four years I was here. And, uh, it certainly has been a negative impact. That's a key resource. (MT10b, lines 285-291)

This analysis of the need for effective informal mentoring reiterates the analysis described in Chapter IV of a departmental climate that is supportive and purposeful hiring of individuals who are interested in collaborating. In effect, this opposes the traditional gender hierarchy and assumption that a successful individual or organization "is portrayed as aggressive, goal oriented, competitive, efficient, but rarely as supportive, kind, and caring" (Acker, 1992, p. 568). The data from this study suggest that in many cases success is dependent on, among other factors, support of colleagues and the organization.

With respect to childcare, only two male faculty members discussed the lack of childcare on campus, compared to six females. Discussion highlighted the importance of adequate childcare to a faculty member's success in addition to the very evident lack of childcare

resources on campus. None of the universities had any form of childcare available on campus or any affiliated childcare centers within close proximity of campus. One male professor noted,

> The academic endeavor I think is one which demands long hours…it would make it easier for them [faculty members] to spend those hours and they would do so willingly if…the demand of their home life was recognized and things were done to make that part of their existence easier. Childcare is one of them. [His university] would profit immensely if they had a K through 8 or K through 12 school associated with [the university]. (MP8, lines 444-450)

This professor suggested that more resources around childcare would help to attract better faculty members and would allow for a better balance for faculty members. It should also be noted that two female faculty members whose institutions have National Science Foundation ADVANCE (ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers) grants, noted that because of these grants there are now opportunities to apply for supplemental funds for childcare in order to attend conferences, or for other financial support faculty members may need to keep their research program active after childbirth. One female associate professor noted that departments "who don't have a lot of women may not have a structure that is accommodating….if they've never had someone who has their kid in childcare they may not realize that it's a real pain in the neck to have a department meeting at 8 in the morning before childcare is open" (FC6, lines 267-271). This lack of accommodation expressed by the department or colleagues could be considered part of "overt decisions and procedures that control, segregate, exclude, and construct hierarchies based on gender" (Acker, 1992, p. 568), or it could be considered naïveté on the part of the department leadership who have not previously had to accommodate faculty members in this way. In

response to this department policy, the associate professor is subsequently taking on an "appropriate female…demeanor and behavior" (Acker, 1992, p. 568) as recognized in the theory of gendered organizations, in the sense that she complied with what has become standard in the department in terms of procedures that excluded some faculty members from participation. She also presumed that this action by the department was because of her colleagues' alleged inexperience accommodating faculty members who have children, and not a result of inflexibility and a tendency to exclude.   Acker (2006) explains:

> In general, work is organized on the image of a white man who is totally dedicated to the work and who has no responsibilities for children or family demands other than earning a living….because women have more obligations outside of work than do men, this gendered organization of work is important in maintaining gender inequality in organizations. (p. 448)

Indeed, the example of scheduling and requiring attendance at an early morning meeting suggest a tendency toward rigidity and not of inclusion.

Summary of Perceptions of Policies/Procedures

In summary, male and female faculty members agreed upon the importance and effectiveness of many of the 16 policies/practices described in this section. This contrasts the results reported by COACHE researchers, where female faculty members rated every policy/ practices, except financial assistance with housing, significantly more important than male faculty members (COACHE, 2007). At least sixty percent of female faculty members rated all policies/practices as important to their success, with the exception of financial assistance with housing, which was only rated important by 31% of female faculty members. The median percentage of female faculty members who rated the 16 survey items important was 83%. Male

faculty members felt similarly, with all 16 policies/procedures rated as important by more than 36% of the male faculty members, with the median of 75% for all 16 policies/ practices. Faculty members rated the level of effectiveness of most policies/ practices similarly, with the exception of paid or unpaid personal leave during the pre-tenure period and stop-the-clock for parental or other family reasons, both of which were rated effective significantly more often by female than male faculty members. The COACHE researchers reported significant differences on effectiveness on an additional five policies/procedures that male faculty members rated significantly less effective than females: financial assistance with housing, formal mentoring, professional assistance for improving teaching, and paid or unpaid research leave. Faculty members of both sexes expressed a need in the interviews for more effective formal mentoring. Female interviewees were more likely than male interviewees to describe a need for additional resources related to childcare.

<div align="center">Employment Satisfaction</div>

This section presents the data collected from the mechanical engineering faculty members concerning their satisfaction with employment in academia. This analysis serves to answer the third and final research question, "how do male and female mechanical engineering faculty members compare with regard to their employment satisfaction in academia." Analysis began with an examination of a subset of seven survey questions that fall under the "Climate, Culture, and Collegiality" and "Global Satisfaction" sections of the COACHE survey and continued with analysis of some of the interview data associated primarily with questions 14 and 15 of the interview protocol, which are restated below:

- Would you say that you are satisfied with being employed in academia?

- If there were one or two things that would increase your satisfaction in academia, what would those things be?

This section begins with an analysis of survey questions related to perceptions of fair treatment followed by levels of satisfaction with environment. The analysis included in Table 17 includes data from four survey questions; three are related to perceptions of fair treatment, and one is related to the faculty members' choice of institution. This set of survey questions had five response categories: strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, and strongly disagree. The number of faculty members who responded to each of these survey questions varied, so the total sample size responding to each survey question is included for reference. The questions related to perceptions of fair treatment were only asked during two years of the survey administration 2007 and 2010, so the sample used in those three questions is about one-quarter the size of the full sample. A 2 x 5 chi-square was computed comparing the level of agreement with each of the survey items related to fair treatment among male and female faculty members. It was found that significantly more male faculty members report that they "strongly agree" with the survey question 'On the whole, I receive fair treatment from my colleagues regardless of gender,' than female faculty members ($\chi^2(4) = 14.903$, $p < .01$). The chi squares for the other three survey questions were found not to be significant and are included in Table 17.

Overall, male faculty members more often strongly agreed that they receive fair treatment regardless of gender, race/ethnicity, or sexual orientation, with a median of 73%. This is in stark contrast with the way that female faculty members responded to these same questions. Much smaller percentages of female faculty members "strongly agreed" that they receive fair treatment regardless of gender (27%), race/ethnicity (58%), or sexual orientation (50%). When combined

with the percentage who "somewhat agreed" the percentages even out slightly, but female

faculty members still agree less often that they receive fair treatment regardless of gender (81%

vs. 91% for males), regardless of race/ethnicity (83% vs. 85% for males), or regardless of sexual

orientation (60% vs. 92% for males).

Table 17. Perceptions of fair treatment by gender of faculty member (in percentages)

	χ^2 (df, N)	Strongly Agree (Male / Female)	Agree (Male / Female)	Neither Agree nor Disagree (Male / Female)	Disagree (Male / Female)	Strongly Disagree (Male / Female)
On the whole, I receive fair treatment from my colleagues regardless of my gender.	14.903, **p = .005 (4, N = 55)	**78 / 27**	13 / 53	5 / 7	3 / 13	3 / 0
On the whole, I receive fair treatment from my colleagues regardless of my race/ethnicity.	2.278, p = .685 (4, N = 53)	73 / 58	13 / 25	10 / 17	2 / 0	2 / 0
On the whole, I receive fair treatment from my colleagues regardless of my sexual orientation.	5.192, p = .075 (4, N = 35)	**80 / 50**	12 / 10	8 / 40	0 / 0	0 / 0
If I could do it all over, I would again choose to work at this institution.	8.615, p = .071 (4, N = 229)	38 / 39	35 / 47	15 / 2	7 / 10	5 / 2

Note. *p<.05, **p<.01, ***p<.001

Figure 16. Level of satisfaction with fair treatment by percentage of male and female faculty
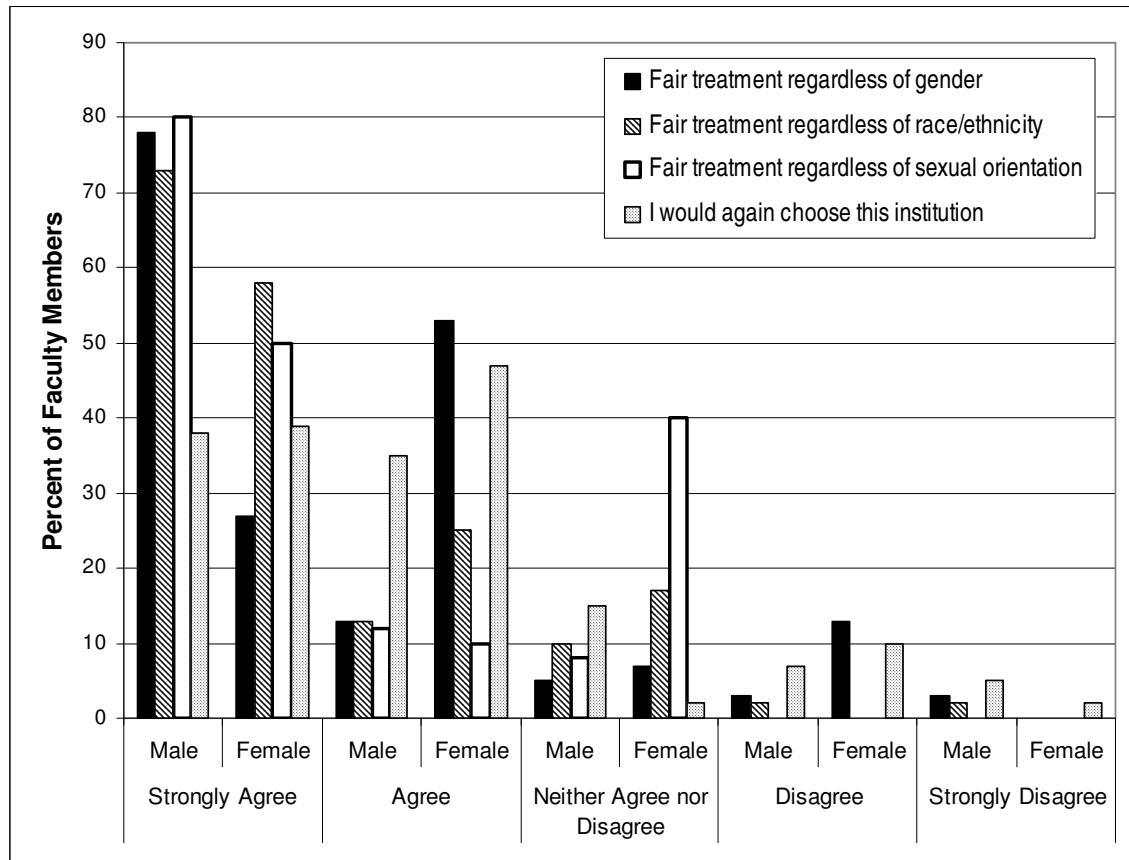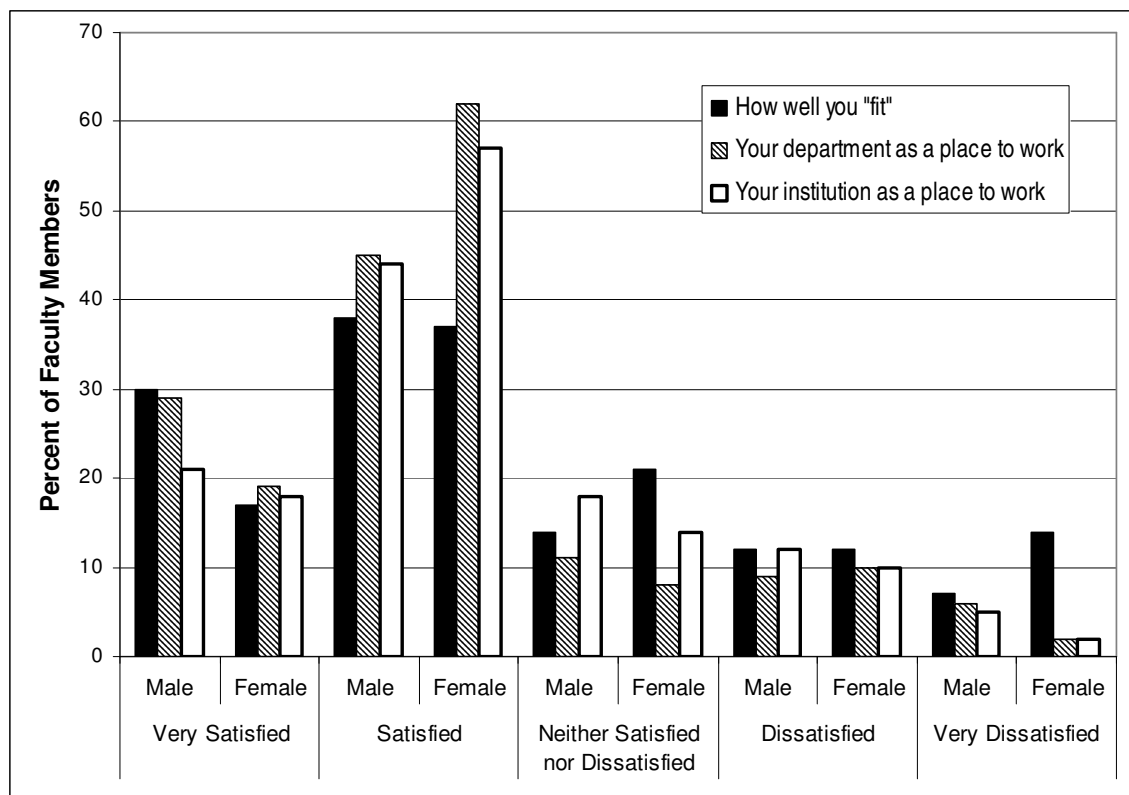
members

With respect to faculty members being asked to consider if they could do it all over, would they choose to work at their institution, female faculty members agreed at higher rates than male faculty members (83% and 73%, respectively). In addition, both male and female faculty members reported that assuming they achieved tenure (or already have attained tenure) they would remain at their institution for the foreseeable future (46% and 37%, respectively) or for the rest of their career (17% and 19%, respectively). To summarize, high percentages of both male and female faculty members appeared to be content with their choice of institution and planned to stay at their current institution.

The next set of survey questions had a different set of five response categories, including: very satisfied, satisfied, neither satisfied nor unsatisfied, unsatisfied, and very unsatisfied. A 2 x 5 chi-square was computed comparing the level of satisfaction with each of the survey items related to aspects of employment among male and female faculty members. No significant differences between female and male faculty members were found for any of these survey items, as displayed in Table 18. Faculty members at percentages similar to those discussed earlier in this paragraph, reported feeling satisfied or very satisfied with their department (80% of females and 73% of males) and institution (74% of females and 70% of males) as places to work. In slight contrast to the previous data, faculty members did not necessarily feel satisfied that they "fit" in their department, with just over half of females and two-thirds of males who reported satisfaction in this area (see Table 18).

Table 18. Percentage of faculty members who are satisfied with aspects of their employment by sex

	χ^2 (df, N)	Very Satisfied (Male / Female)	Satisfied (Male / Female)	Neither Satisfied nor Dissatisfied (Male / Female)	Dissatisfied (Male / Female)	Very Dissatisfied (Male / Female)
How well you "fit" (e.g., your sense of belonging, your comfort level) in your department	6.319, p = .177 (4, N = 235)	30 / 17	38 / 37	14 / 21	12 / 12	7 / 14
Your department as a place to work	5.679, p = .224 (4, N = 233)	29 / 18	45 / 62	11 / 8	9 / 10	6 / 2
Your institution as a place to work	3.080, p = .545 (4, N = 233)	21 / 18	44 / 57	18 / 14	12 / 10	5 / 2

Figure 17. Level of satisfaction with aspects of employment by percentage of male and female faculty members

Interview data revealed similar results with respect to satisfaction and "fit". Four female faculty members described difficulty in terms of fitting in with their colleagues, feeling isolated, and feeling forced to change how they would normally act. No male faculty members described anything related to these topics. Many of the female full professors were the only female in their department for a long time, as FP8 iterates here, "I was the first female faculty, I felt a little bit weird. Um, there were a few faculty that would never speak to me. It was a little odd." (line 89). She had stayed at the same institution for her entire career up to the point of the interview and yet apparently felt like she had fit in (she was the department head). She also noted that she is, overall, satisfied with employment in academia. An assistant professor who had just submitted

her tenure package described her feelings as she progressed through her first five years in her position:

> I felt like I was on an island there. I think it's a lack of confidence to some extent and you know, you don't know if you're going to be sticking around. So it's difficult to, I think, fit in and feel good. And during that time, of course, I was having babies and dealing with all the stresses that go along with that. It was just seeming like an untenable situation for quite awhile. (FT1, lines 478-496)

She stated that she is mildly satisfied with employment in academia but now feels empowered to work on the research she feels is important. Other female faculty members described changing to fit with their colleagues, as FP7 explains: "I think I've had to become more aggressive, more open, more you know, charge ahead, really out of my comfort zone. And I'm not even close to some of the, aggressiveness, that's in this culture. I'm not even close" (FP7, line 437). Where FP7 again was the first female faculty member in her department, and even though she had served as department head earlier in her career, she still felt a need to exit her "comfort zone" in order to engage with her colleagues. In terms of satisfaction with employment in academia, FP7 said that "being a full professor is the absolute best job in the world. And the only problem is there's too much exciting to do" (line 394). One assistant professor took a stronger stance with respect to her efforts to change to fit in with her colleagues when she stated:

> You don't have to change yourself in order to fit in because there's no particular, you know small groups that are formed that you need to form into....you don't have to care about other people, nobody cares about you. That's my impression. So basically you either survive or you die. (FT3, lines 559-563)

This assistant professor was in a large department that was not centrally located in one building, so interactions with colleagues did not happen organically as in some of the other institutions. FT3 compared academia to employment in industry and said that in relation to satisfaction academia was more suitable to her lifestyle. The rest of the female faculty members who were interviewed reported varying levels of satisfaction; the full professors expressed that they were very satisfied, the associate professors ranged from very satisfied to satisfied, and the assistant professors were less likely to report that they were satisfied without including a caveat, such as "I think so" (FT7, line 660), or "depends on the day" (FT1, line 410). In contrast, all but two of the male faculty members reported being fully satisfied. Two male full professors described the ups and downs of academia and did not express overall satisfaction with their employment.

Summary of Employment Satisfaction

In general, similar percentages of male and female faculty members were satisfied with being employed in academia. Less than one-third of female faculty members strongly agreed that they receive fair treatment from their colleagues regardless of gender, and only one-half of female faculty members strongly agreed that they receive fair treatment from their colleagues regardless of sexual orientation. Approximately the same percentage of male and female faculty members reported they would choose to work at their institution if they could do it all over and reported satisfaction with their department and institution as places to work. A little more than half of the female faculty members were satisfied with how well they "fit" in their department, and the interview data showed consistency with this finding.

Summary

This chapter presented the second half of the data analysis related to three of the five research questions in this study. The research questions addressed in this chapter pertain to

perceptions of resource allocations, satisfaction with policies/procedures, and satisfaction with employment in academia all of which are compared based on faculty member gender. Data analysis presented in this chapter included descriptions of the survey data using frequency tables, calculation of chi square statistics to determine differences between faculty members by gender, and use of qualitative interview data to support and extend the quantitative analysis.

In terms of perceptions of resource allocations, faculty members did not differ widely based on gender. Males and females reported similar levels of satisfaction with the quality of clerical/administrative, research, teaching, and computing services, but female faculty members reported feeling "dissatisfied" significantly more often than male faculty members with respect to the amount of access to Teaching Fellows, Graduate Assistants, et al.. Female faculty members were much more likely than male faculty members to describe a need for additional resources related to research support and less transparency, fairness, and equity in assignment of space during their interviews.

Faculty members agreed upon the importance and effectiveness of many policies/practices. A higher percentage of female faculty members than male faculty members rated almost all of the policies/practices as important to their success. Faculty members rated the level of effectiveness of most policies/ practices similarly, with the exception of paid or unpaid personal leave during the pre-tenure period and stop-the-clock for parental or other family reasons, both of which were rated effective significantly more often by female than male faculty members. Faculty members of both sexes expressed a need in the interviews for more effective formal mentoring.

In terms of employment satisfaction, female and male faculty members did not differ in their level of satisfaction with being employed in academia. Two-thirds of female faculty

members did not agree that they receive fair treatment regardless of gender. Male faculty

members overwhelmingly felt that they were treated fairly regardless of gender, race/ethnicity, or

sexual orientation. Faculty members did not differ by gender in terms of whether they would

choose their current institution again if they make the choice again.

CHAPTER VI: DISCUSSION

Introduction

The purpose of this mixed-methods study was to better understand how female mechanical engineering faculty members' career experiences in academia affect their satisfaction. The study examined the levels of satisfaction reported by mechanical engineering faculty members in terms of: a) departmental climate, b) nature of work, c) resource allocations, d) departmental policies/practices, and e) overall satisfaction. The study compared the levels of satisfaction reported in survey data collected from 2005-2010 with interview data collected from a subset of the survey population.

Chapter I outlined the rationale for studying the satisfaction of female mechanical engineering faculty members. This chapter outlined the need to focus narrowly on one of the most male-dominated academic disciplines by analyzing the broad numeric trends in survey data and focused responses from the in-depth interview data in order to provide a basis for policy changes in mechanical engineering departments. Chapter II discussed previous research related to the climate in academia and a theoretical foundation related to gendered organizations. Chapter III presented the methodology used in the study including the research design, the data collection and analysis procedures, and a summary of the demographic characteristics of the sample. Chapter IV included both quantitative and qualitative results related to perceptions of departmental climate and how these perceptions differ based on academic rank and level of satisfaction with respect to the nature of work and how reported satisfaction differs based on gender. Chapter V displayed results by gender of perceptions of resource allocations, level of satisfaction with departmental policies/procedures, and level of satisfaction with employment in academia. Chapter VI presents a discussion of the findings and a comparison of the findings to

literature. Recommendations based on the results of the study are presented for mechanical engineering departments, mechanical engineering faculty members, and future research.

<p style="text-align:center">Discussion</p>

The data collected in this study resulted in a number of important findings. This chapter presents a discussion of how gendered organizational theory can be used to understand six of the most salient findings presented in this study, and how these findings support or refute current literature on climate in academia. The topics discussed in this chapter include: colleagues' respect for life responsibilities, female faculty members' roles in the department, an upper limit on teaching obligations, junior faculty interactions with senior faculty, mentoring, and lack of 'fit'.

<p style="text-align:center">*Departmental Colleagues' Respect for Life Responsibilities*</p>

This study found that based on the survey data there are no gender differences in perceptions of institutional and departmental colleagues' sensitivity toward balance or having and raising children. Female faculty members more often described during the interviews that their department colleagues were less supportive of family issues or created unnecessary competition. The findings of this study align with the conclusions reached by a number of other studies with respect to the role of family responsibility to explain gender differences in academia (e.g., Sax et al., 2002; Xu, 2008).   Though the qualitative findings suggest that female faculty members are more likely to describe their department as less supportive, the quantitative results do not support this assertion. There is no difference by gender in terms of perceptions of sensitivity toward balance and having and raising children, but a majority of faculty members did not agree that their institution and departmental colleagues were sensitive to these issues, suggesting that there is a gendered division in terms of allowed behavior (Acker, 1990).

Allowed behavior in this example would be considered that which is standard; in other words, if faculty members report a less supportive department in terms of having and raising children and balance, then the department is likely organized in a way that doesn't take these issues into consideration. Acker (2006) explains that "in general, work is organized on the image of a white man who is totally dedicated to the work and who has no responsibilities for children or family demands" (p. 448), and since mechanical engineering departments are dominated by male faculty members, Acker's description of work seems to be accurate. Sallee (2012) furthers this opinion of a gendered image of work by arguing that "organizations are gendered in that they are built on the notion of the ideal worker who has unlimited time to give to work and no distractions in the home" (p. 5). In other words, a faculty member should not be concerned with anything outside of work, and should prioritize their research agenda over all other responsibilities because that is what is required to achieve tenure.

The findings from the current study contrast that of van Anders (2004), who reported that "that more men than women think that academia is compatible with having children" (p. 519), as well as that of a study by MIT (1999) where female assistant professors more frequently mentioned a concern for managing family and work responsibilities. There are at least a few institutions that are working to change the perceptions of their faculty members, in hopes that the gendered images of organization and work noted earlier do not continue to be pervasive. These institutions are providing professional development to search committees and department leadership so that individuals who take on departmental leadership roles or participate on committees have a better understanding and gain perspective on the concerns of female faculty members, with the ultimate goal of recruiting and retaining women through tenure (e.g., Stewart, LaVaque-Manty & Malley, 2004; WISELI, 2002). Though mechanical engineering departments

appear to be more accepting and supportive of home-work balance than in the past, there is still a feeling that colleagues lack sensitivity toward family issues. This could be a result of the fact that male full professors are still the majority, and they are not in the same life stage as their junior colleagues so they aren't as sensitive towards these issues. This perceived lack of sensitivity affects all junior faculty members and requires that leadership and senior colleagues pay "attention to [their] practicing of gender" (Yancey Martin, 2003, p. 343) so that they consider how their actions impact their colleagues and how modifying their actions could positively impact the environment in a department.

Female Faculty Members' "Gendered" Roles in the Department

This study found that female faculty members more often described being required to do high levels of service for their university than their male colleagues described. They also described a difference in the types of assignments required by female faculty members and suggested that their male colleagues would not likely agree to a similar assignment. The service requirements discussed in the interviews, such as recruiting students or faculty members, take time away from the most intensive requirement for tenure, that of obtaining funding and publishing research. Therefore, the large time commitment involved with these types of assignments can negatively impact faculty members. This finding is aligned with a number of other studies with respect to the unequal distribution of 'non-traditional' service assignments and the resulting time away from research required of these assignments (e.g., Bird, 2011; Bird et al., 2004; Park, 1996; Ropers-Huilman, 2000). It is possible that male faculty members may perceive the female faculty member's role in a department as that of "'mothers of the department': by creating a comfortable atmosphere, making coffee and organizing different social events" (Kantola, 2008, p. 205). This is not the same type of role that a male faculty

member is expected to take on. Many studies suggest that male faculty members are more likely

to be a member of a tenure and promotions evaluating committee or leadership team as part of

their service requirement (Bird, 2011; Long et al., 1993; Martin, 1994). Bird (2011) argues that

when males dominate membership on either of these two types of service committees it

"increases the likelihood that what men take for granted as normal and appropriate will inform

the ways in which they interpret" (p. 210) a tenure package or a policy within a department. This

behavior of assuming that there is a "normal and appropriate" (p. 210) way in which tenure is

achieved or policies are developed, could negatively affect pre-tenure faculty members' ability to

achieve tenure if they don't match this accepted behavior. This would be considered a gendered

division of labor where "men are almost always in the highest positions of organizational power"

(Acker, 1990, p. 146), and in this position of power they can make judgments about their faculty

member colleagues based on what men determine is "normal and appropriate" (Bird, 2011,

p. 210). In addition, it forces the construction of an image of a successful faculty member as one

who practices behaviors that "are normatively, culturally, and/or empirically associated with

men" (Martin, 2003, p. 361); suggesting that one cannot be successful if one doesn't behave in

this manner. Kantola (2008) notes that the types of tasks described above that are assigned to

women are not valued in academia and contribute "little scientific credit in terms of career

development" (p. 206) and ultimately serving as a detractor from activities that would contribute

to career development. As mentioned earlier, faculty members must do a better job of

considering how they can modify their automatic reaction, and instead empathize with and

consider how their colleagues are different (either by biological, physical, or personality

characteristics) than they are and therefore may have a different viewpoint.

Teaching Perceptions of Male and Female Faculty Members

Faculty members described an upper limit on teaching obligations as the most important policy to their success and the majority of male faculty members reported that it was also the most effective policy. Faculty members in this study described other policies related to teaching during their interviews such as, an increase in teaching obligations if a faculty member does not bring in sufficient external grant funding, and assigning a set of courses to a faculty member that they are responsible for pre-tenure so that they do not have to develop new courses every year. There were no significant gender differences with respect to teaching obligations reported in this study. In contrast, researchers at MIT (1999) found that some science departments had unequal resources and reward for male and female faculty members, including teaching assignments, among other things. Some faculty members noted that situations differ, and assigning a faculty member an additional course to teach would take more time away from research and perhaps cause him or her to fall further behind in research funding expectations.   This policy of rigidity could be considered a gendered division in power and behavior (Acker, 1990) whereby policies are put in place and maintained though they may be detrimental to the success of faculty members. Examples of male faculty members who were assigned to teach exceedingly high course loads and who were not given powerful positions within their department do not easily fit within Acker's theory. Further analysis is needed to provide an understanding of how some male faculty members' assigned roles within a department suggest that they are perceived to be taking on traits that are more characteristically female, and how this relates to their satisfaction. In this case, as in others discussed in this study, when a policy for an upper limit on teaching is lacking in a department, it is detrimental to both female and male faculty members, suggesting a need for increased flexibility and transparency in how policies/practices are implemented in a department.

Interactions with Senior Faculty Members Inconsistent Along Gender Lines

This study found that less than half of the female faculty members reported feeling satisfied with interactions with tenured faculty, compared to more than half of the male faculty members reported feeling satisfied. Ponjuan, Conley and Trower (2011) similarly found a significant difference between pre-tenure female and male faculty members with respect to their relationship with senior colleagues. Though full professors describe a culture of collaboration in their departments, the experiences of assistant and associate professors suggest disconnect. Male and female professors from the same university have different perceptions on the quantity and quality of collaborations that occur at their universities. Female faculty members more often reported feeling like no one cares about their success and that they are isolated because they do not have interactions with colleagues. This finding supports that of other studies where female faculty members feel like they are neglected by their colleagues or that they are invisible to their colleagues (Etkowitz, Kemelgor, and Uzzi, 2000; MIT, 1999; Steffen-Fluhr, 2006). In addition, other research studies confirm that the quality of relationships with colleagues is a major indicator of satisfaction for faculty (Hagedorn, 1996; Roper-Huilman, 2000). The theory of gendered organization suggests that gendered interactions can have "patterns that enact dominance and submission" (Acker, 1990, p. 147). That female faculty members feel isolated and unengaged by their colleagues suggests that their male colleagues are choosing not to engage in conversation with them, and that communication and information is transmitted via some form of male network that they are not privy to (Fox, 1991; Kantola, 2008). In fact, Kantola (2008) suggests that because female faculty members are not included in unofficial flows of information, their career development can be slowed. It is also possible that an unfriendly

environment causes some female faculty members to choose not to engage with their colleagues, limiting their exposure to research conversations and potential collaborations.

Mentoring is Pivotal

Findings from this study showed that mentoring was important to faculty member success. This finding supports that of many other studies that showed the importance of mentoring to female faculty member's career satisfaction (August & Waltman, 2004; Brown, Van Ummeren & Hill, 2002). This study also showed that both formal and informal mentoring were reported to be important to the success of faculty members, but formal mentoring was much less effective than informal mentoring. There was a significant difference by gender in terms of importance of both types of mentoring, with male faculty members feeling that mentoring was less important than females. Acker (2008) noted that "women generally have had more difficulty than men in finding and enlisting the help of mentors" (p. 292), which could contribute to why female faculty members reported that formal mentoring was ineffective in the current study. This difficulty in enlisting a mentor suggests an image of a department as non-supportive, reinforcing divisions along gender lines (Acker, 1990). Associate and full professors felt that mentoring was much more effective than did the assistant professors. Chesler and Chesler (2002) explain that mentoring could take many forms and that a single mentor may not always meet the needs of a mentee. They also suggest that "in order for the potential benefits of mentorship to be realized, the organization's reward system, culture, norms and definitions of tasks and functions must value and encourage relationship-building activities" (Chesler & Chesler, p. 53), implying that not only must individuals consider mentorship differently, but the organization must change to encourage mentoring. For effective mentoring to occur, the climate of a department must support and encourage it; in opposition to a typical gendered organization

that assumes that success "is portrayed as aggressive, goal-oriented, competitive, efficient, but rarely as supportive, kind, and caring" (Acker, 1992, p. 568).

Female Faculty Members Perceived Lack of 'Fit'

Findings from this study showed a slightly higher percentage of female faculty members than male faculty members reported being dissatisfied with how well they 'fit' within their department. Though this difference in percentage was not statistically significant, it is an important finding because more than one-quarter of females reported feeling dissatisfied with respect to 'fit'. Other research has shown that males "who do not fit the norms of the ideal worker" (Sallee, 2012, p. 7) can also feel discriminated against in their working environment. In addition, the current study found that less than one-third of female faculty members agree that they are treated fairly regardless of their gender, compared to over three-quarters of male faculty members who agreed with this statement. This finding supports research that reported perceptions of less equitable treatment by female faculty members and faculty of color (Seifert & Umbach, 2008). In addition, this research showed that "as the proportion of women in the discipline increased, the perception of equitable treatment for women and faculty of color decreased" (p. 377). This research helps to explain why the results from the current study show a high percentage of female mechanical engineering faculty members who report that they are not treated fairly regardless of their gender. Kantola (2008) suggests that "women's and men's different ways of interpreting their positions and chances in the university and at the departmental level are part of the way a gendered organization works" (p. 217) and if, as shown in the current study, women perceive an inequality in their treatment by colleagues, they likely also perceive themselves as in a less powerful position than male colleagues.

Summary

The results of this study identified the role of gendered divisions of labor, gendered divisions of allowed behavior, gendered symbols, and gendered interactions as reasons why female mechanical engineering faculty members are less satisfied with employment in academia and the nature of their work. Gendered divisions of labor were evident in inequitable distribution of service assignments, and the assumption that female faculty members will become the 'motherly' figure within the department while male faculty members will take on a position of power. In addition, hierarchies were formed when these different duties were attributions different values, with male assignments having more value. Gendered divisions of behavior were highlighted by the discussion of male faculty members' lack of support and sensitivity toward family issues and departmental leaders' inflexibility with respect to policies and procedures.

Gendered symbols could be seen to operate on multiple levels. Symbols defined what a mechanical engineering faculty member looks like. Gendered symbols or images included the dominant white male mechanical engineering faculty member as an ideal worker, the image of a successful faculty member as one who practices behaviors traditionally associated with men, and the image of a successful department as efficient and non-supportive.

Gendered interaction could be seen in multiple contexts. In some respects the context of the gendered interaction came about because of "non-events" where there existed male networks for transmission of tacit knowledge and females were excluded from the collegial information-sharing. Mentoring stood out as an example of gendered interaction whereby male assistant professors were more likely to receive supportive mentoring than female assistant professors.

Limitations of the Study

The current study has a variety of limitations, and this section presents some of the most prevalent ones. The sample size of the interview participants was much smaller than that of the survey respondents. This interview sample was also limited to only ten institutions. It is possible that the interview data included in this study is biased because it is based on such a limited dataset. In addition, as a former student of two mechanical engineering departments (I went to different institutions for my B.S. and M.S. degrees.), my own experiences in these departments and institutions shape the way I collected data, analyzed data, and constructed implications for this research. In an attempt to limit my personal bias, I used the lens of the theory of gendered organizations to review the data. Future projects would benefit from multiple researchers to independently review and code interview data and a larger interview sample overall.

Recommendations for Future Research

Future research topics based on the results from the current study should cover a wide range of topics. A longitudinal study could be implemented with the interview participants of the current study to see how things have changed at their department and institution since the data were collected for the current study. This longitudinal study could also consider whether the assistant professors have been granted tenure and whether any faculty members had taken on leadership positions (and implemented policies that they suggested during the interviews for the current study) or moved to a different university. A smaller study of a similar nature could involve the interview participants whose universities received NSF ADVANCE grants, and could focus on an assessment of whether the implementation of the ADVANCE grant and any associated policy changes at the university resulted in any significant changes to the faculty

members' levels of satisfaction. To better understand how climate and satisfaction effect ability

to be granted tenure, a qualitative study of 10-15 faculty members who were not granted tenure

or who reported having borderline tenure decisions coulld be done. This type of study would

allow for a more complete understanding of which aspects of the academic environment were

lacking for these faculty members, and it would allow specific departments to modify their

policies and practices to be more supportive of pre-tenure faculty members. Another possible

study would involve in-depth case study research of a few departments within an engineering

college to assess how levels of support at the college and department levels effect faculty

member satisfaction and attrition. These are just a few of the long list of topics that could be

analyzed through further research.

<div align="center">Recommendations for Mechanical Engineering Departments</div>

In closing, the outcomes of this study suggest that even though mechanical engineering

departments have changed their policies and practices to be more inclusive over the last 15-20

years, changes are still required if departments want to successfully tenure female faculty

members. Department chairs/heads must lead by example, be empathetic toward each faculty

member, and be transparent yet flexible in decision-making and as they develop and implement

policy. Department leaders must encourage senior faculty members to actively seek out junior

colleagues for conversations about research, teaching, and possible collaborations. Department

chairs/heads should make this effortless for faculty members by: locating mechanical

engineering faculty members' offices in close vicinity to one another; scheduling regular

research seminars to encourage constructive conversation about theory, analysis, and research

methods; and, coordinating a formal mentoring program that connects junior and senior faculty

members whose research agendas would allow for immediate collaboration work. Junior faculty

members need to take advantage of opportunities to network with colleagues from across the university and they must take initiative to meet with their mentors regularly for suggestions and counsel. While these findings are not all encompassing for academia, they do provide some direction to mechanical engineering departments in terms of where policies should move to increase the pipeline of female faculty members in the professoriate. Lasting and meaningful change in policies and practices will not only increase the satisfaction of female mechanical engineering faculty members, but will also create a positive environment for students, staff, and the mechanical engineering professoriate as a whole.

APPENDIX A

Interview Protocol

1. Please describe the culture or atmosphere in your department.

2. Who are the department leaders? [full profs, dean?]

3. What is your role in the department?

4. To what extent do you feel that you can do innovative, collaborative research here?

5. What types of interactions do you have with colleagues? Do you tend to initiate interactions or do others?

6. Are you satisfied with the number and quality of your relationships with colleagues in your department? In other departments?

7. How does the amount of time you spend on teaching, research, and service compare? Are your experiences typical for both males and females?

8. How are teaching assignments designated? Do you agree with this process?

9. How is committee work assigned? Do you agree with this process?

10. What types of resources do you have available to you as a mechanical engineering faculty member? Are these resources typically available to all faculty members?

11. What resources do you need to be successful as a mechanical engineering faculty member, but don't currently have access to?

12. How is space allocated in your department? Who has the "prime" real estate?

13. What types of mentoring have you received as an engineering faculty member? Are your experiences typical for both males and females?

14. How does the culture within engineering departments influence the success of women engineering faculty?

APPENDIX B

Zoomerang Survey Questions

1. What is the highest degree you have earned?
   o Doctorate (Ph.D., J.D., M.D., etc.)
   o Master's
   o Bachelor's
   o Associate's
   o Decline to answer

2. In what year did you earn your highest degree?

3. Did you hold a postdoctoral appointment?
   o Yes
   o No
   o Decline to answer

4. Are you employed full-time in a position on the tenure-track?
   o Yes
   o No

5. Do you have tenure?
   o Yes
   o No

6. Is this your first tenure-track appointment?
   o Yes
   o No
   o Decline to answer

7. How many years on the tenure track did you complete elsewhere?
   o 1 year or less
   o 2 years
   o 3 years
   o 4 years
   o 5 or more years
   o Full tenure
   o Decline to answer

8. Did your current faculty appointment begin with credit for prior service elsewhere?
   o Yes
   o No
   o Decline to answer

9. How many years of credit for prior service did you receive?

- o   1 year or less
- o   2 years
- o   3 years
- o   4 years
- o   5 or more years
- o   Decline to answer

10. Please indicate the year in which your current faculty appointment began:

11. What is your rank?
- o   Professor
- o   Associate Professor
- o   Assistant Professor or Assistant Professor (Conditional)
- o   Instructor/Lecturer
- o   Other
- o   Decline to answer

12. Do you hold a joint appointment or budgetary cross-appointment (formal responsibilities in more than one department)?
- o   Yes
- o   No
- o   Decline to answer

13. What is your race? (Please check all that apply.)
- o   **American Indian or Native Alaskan**: A person having origins in any of the original people of North and South America (including Central America)
- o   **Asian, Asian-American, Asian-Canadian, or Pacific Islander:** A person having origins in any of the original peoples of the Far East, Pacific Islands, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, Guam, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, and Samoa.
- o   **White (non-Hispanic):** A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.
- o   **Black, African-American, or African-Canadian**: A person having origins in any of the black racial groups of Africa.
- o   **Hispanic or Latino**: A person of Cuban, Mexican, Puerto Riccan, Brazilian, South or Central American, or other Hispanic or Latino culture or origin.
- o   **Other**
- o   **Multiracial**
- o   Decline to Answer.

14. What is your citizenship status?
- o   U.S. citizen
- o   Non-U.S. citizen
- o   Decline to answer

15. What is your gender?

      o Male
      o Female
      o Decline to answer

16. In what year were you born?

17. How many children under the age of 18 live with you at home?

18. How many other dependents (e.g., an adult who requires your care) live with you at home?

19. Which statement most clearly describes your household's employment situation?
      o I do not have a spouse/partner
      o My spouse/partner is not employed
      o My spouse/partner is employed full-time at this institution
      o My spouse/partner is employed full-time elsewhere
      o My spouse/partner is employed part-time at this institution
      o My spouse/partner is employed part-time elsewhere
      o Decline to answer

20. Do you and your spouse reside in separate communities for work reasons?
      o Yes
      o No
      o Decline to answer

TENURE
This set of questions addresses various aspects surrounding tenure in your department.

21. Please indicate how clear or unclear you feel the following aspects of the tenure process are:

1	2	3	4	5	n/a
Very Clear	Fairly clear	Neither Clear nor unclear	Fairly unclear	Very unclear	

I find the tenure ***process*** in my department to be…

1	2	3	4	5	n/a
Very Clear	Fairly clear	Neither Clear nor unclear	Fairly unclear	Very unclear	

I find the tenure ***criteria*** (what things are evaluated) in my department to be…

1	2	3	4	5	n/a
Very Clear	Fairly clear	Neither Clear nor unclear	Fairly unclear	Very unclear	

I find the tenure *standards* (the performance threshold) in my department to be…

1	2	3	4	5	n/a
Very Clear	Fairly clear	Neither Clear nor unclear	Fairly unclear	Very unclear	

I find the the *body of evidence* that will be considered in making my tenure decision to be…

1	2	3	4	5	n/a
Very Clear	Fairly clear	Neither Clear nor unclear	Fairly unclear	Very unclear	

My sense of whether or not I will achieve tenure is …

1	2	3	4	5	n/a
Very Clear	Fairly clear	Neither Clear nor unclear	Fairly unclear	Very unclear	

THE NATURE OF YOUR WORK
The next set of items explores your day-to-day activities as a faculty member.

22. Please indicate your level of satisfaction or dissatisfaction within the following aspects of your work.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The way you spend your time as a faculty member.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The number of hours you work as a faculty member in an average week.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The level of courses you teach.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The number of courses you teach.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The degree of influence you have over the courses you teach.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The discretion you have over the content of the courses you teach.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The number of students you teach.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The quality of undergraduate students with whom you interact.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

THE NATURE OF YOUR WORK
These items continue to explore your level of satisfaction or dissatisfaction with the following aspects of your work.

23. Please indicate your level of satisfaction or dissatisfaction with the following aspects of your work.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The amount of time you have to conduct research/produce creative work.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The amount of external funding you have expected to find.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The influence you have over the focus of your research/creative work.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The quality of facilities (i.e., office, labs classrooms).

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The amount of access you have to Teaching Fellows, Graduate Assistants, et al.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

24. How satisfied are you with the quality of these support services?

Clerical/administrative services

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

Research services

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

Teaching services

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

Computing services

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

POLICIES AND PRACTICES
This set of questions addresses faculty policies and practices common at colleges and universities.

Regardless of whether the following policies or practices currently apply to your institution, please rate *how important or unimportant each would be to your success.* Then rate *how effective*

or ineffective each has been at your institution. For each item, please mark the appropriate column.

POLICY/PRACTICE
   1) Formal mentoring program for junior faculty

25. Importance or unimportance of policy to your success:
   - o   Very important
   - o   Important
   - o   Neither important nor unimportant
   - o   Unimportant
   - o   Very unimportant

26. Effectiveness or ineffectiveness of policy at your institution:
   - o   Very effective
   - o   Effective
   - o   Neither effective nor ineffective
   - o   Ineffective
   - o   Very ineffective
   - o   Not offered at my institution
   - o   I don't know/not applicable

POLICY/PRACTICE
   2) Informal mentoring

27. Importance or unimportance of policy to your success:
   - o   Very important
   - o   Important
   - o   Neither Important nor unimportant
   - o   Unimportant
   - o   Very unimportant

28. Effectiveness or ineffectiveness of policy at your institution:
   - o   Very effective
   - o   Effective
   - o   Neither effective or ineffective
   - o   Ineffective
   - o   Very ineffective
   - o   Not offered at my institution
   - o   I don't know/not applicable

POLICY/PRACTICE
   3) Periodic, formal performance reviews for junior faculty

29. Importance or unimportance of policy to your success:
   - o   Very important

- o Important
- o Neither Important nor unimportant
- o Unimportant
- o Very unimportant

30. Effectiveness or ineffectiveness of policy at your institution:
    - o Very effective
    - o Effective
    - o Neither effective or ineffective
    - o Ineffective
    - o Very ineffective
    - o Not offered at my institution
    - o I don't know/not applicable

POLICY/PRACTICE
4) Written summary of periodic performance reviews for junior faculty

31. Importance or unimportance of policy to your success:
    - o Very important
    - o Important
    - o Neither Important nor unimportant
    - o Unimportant
    - o Very unimportant

32. Effectiveness or ineffectiveness of policy at your institution:
    - o Very effective
    - o Effective
    - o Neither effective or ineffective
    - o Ineffective
    - o Very ineffective
    - o Not offered at my institution
    - o I don't know/not applicable

POLICY/PRACTICE
5) Professional assistance in obtaining externally funded grants

33. Importance or unimportance of policy to your success:
    - o Very important
    - o Important
    - o Neither Important nor unimportant
    - o Unimportant
    - o Very unimportant

34. Effectiveness or ineffectiveness of policy at your institution:
    - o Very effective
    - o Effective

- o Neither effective or ineffective
- o Ineffective
- o Very ineffective
- o Not offered at my institution
- o I don't know/not applicable

POLICY/PRACTICE
6) Professional assistance for improving teaching

35. Importance or unimportance of policy to your success:
- o Very important
- o Important
- o Neither Important nor unimportant
- o Unimportant
- o Very unimportant

36. Effectiveness or ineffectiveness of policy at your institution:
- o Very effective
- o Effective
- o Neither effective or ineffective
- o Ineffective
- o Very ineffective
- o Not offered at my institution
- o I don't know/not applicable

POLICY/PRACTICE
7) Travel funds to present papers or conduct research

37. Importance or unimportance of policy to your success:
- o Very important
- o Important
- o Neither Important nor unimportant
- o Unimportant
- o Very unimportant

38. Effectiveness or ineffectiveness of policy at your institution:
- o Very effective
- o Effective
- o Neither effective or ineffective
- o Ineffective
- o Very ineffective
- o Not offered at my institution
- o I don't know/not applicable

POLICY/PRACTICE
8) Paid or unpaid *research* leave during the pre-tenure period

39. Importance or unimportance of policy to your success:
  - o Very important
  - o Important
  - o Neither Important nor unimportant
  - o Unimportant
  - o Very unimportant

40. Effectiveness or ineffectiveness of policy at your institution:
  - o Very effective
  - o Effective
  - o Neither effective or ineffective
  - o Ineffective
  - o Very ineffective
  - o Not offered at my institution
  - o I don't know/not applicable

POLICY/PRACTICE
  9) Paid or unpaid *personal* leave during the pre-tenure period

41. Importance or unimportance of policy to your success:
  - o Very important
  - o Important
  - o Neither Important nor unimportant
  - o Unimportant
  - o Very unimportant

42. Effectiveness or ineffectiveness of policy at your institution:
  - o Very effective
  - o Effective
  - o Neither effective or ineffective
  - o Ineffective
  - o Very ineffective
  - o Not offered at my institution
  - o I don't know/not applicable

POLICY/PRACTICE
  10) An upper limit on committee assignments for tenure-track faculty

43. Importance or unimportance of policy to your success:
  - o Very important
  - o Important
  - o Neither Important nor unimportant
  - o Unimportant
  - o Very unimportant

44. Effectiveness or ineffectiveness of policy at your institution:
- o Very effective
- o Effective
- o Neither effective or ineffective
- o Ineffective
- o Very ineffective
- o Not offered at my institution
- o I don't know/not applicable

POLICY/PRACTICE
11) <u>An upper limit on teaching obligations</u>

45. Importance or unimportance of policy to your success:
- o Very important
- o Important
- o Neither Important nor unimportant
- o Unimportant
- o Very unimportant

46. Effectiveness or ineffectiveness of policy at your institution:
- o Very effective
- o Effective
- o Neither effective or ineffective
- o Ineffective
- o Very ineffective
- o Not offered at my institution
- o I don't know/not applicable

POLICY/PRACTICE
12) <u>Peer reviews of teaching or research/creative work</u>

47. Importance or unimportance of policy to your success:
- o Very important
- o Important
- o Neither Important nor unimportant
- o Unimportant
- o Very unimportant

48. Effectiveness or ineffectiveness of policy at your institution:
- o Very effective
- o Effective
- o Neither effective or ineffective
- o Ineffective
- o Very ineffective
- o Not offered at my institution
- o I don't know/not applicable

POLICY/PRACTICE
   13) <u>Childcare</u>

49. Importance or unimportance of policy to your success:
   o Very important
   o Important
   o Neither Important nor unimportant
   o Unimportant
   o Very unimportant

50. Effectiveness or ineffectiveness of policy at your institution:
   o Very effective
   o Effective
   o Neither effective or ineffective
   o Ineffective
   o Very ineffective
   o Not offered at my institution
   o I don't know/not applicable

POLICY/PRACTICE
   14) <u>Financial assistance with housing</u>

51. Importance or unimportance of policy to your success:
   o Very important
   o Important
   o Neither Important nor unimportant
   o Unimportant
   o Very unimportant

52. Effectiveness or ineffectiveness of policy at your institution:
   o Very effective
   o Effective
   o Neither effective or ineffective
   o Ineffective
   o Very ineffective
   o Not offered at my institution
   o I don't know/not applicable

POLICY/PRACTICE
   15) <u>Stop-the-clock for parental or other family reasons</u>

53. Importance or unimportance of policy to your success:
   o Very important
   o Important
   o Neither Important nor unimportant

> o Unimportant
> o Very unimportant

54. Effectiveness or ineffectiveness of policy at your institution:
> o Very effective
> o Effective
> o Neither effective or ineffective
> o Ineffective
> o Very ineffective
> o Not offered at my institution
> o I don't know/not applicable

POLICY/PRACTICE
16) <u>Spousal/partner hiring program</u>

55. Importance or unimportance of policy to your success:
> o Very important
> o Important
> o Neither Important nor unimportant
> o Unimportant
> o Very unimportant

56. Effectiveness or ineffectiveness of policy at your institution:
> o Very effective
> o Effective
> o Neither effective or ineffective
> o Ineffective
> o Very ineffective
> o Not offered at my institution
> o I don't know/not applicable

57. Please indicate your level of agreement or disagreement with the following statements:

1	2	3	4	5	6	7
Not applicable/ I don't know	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Decline to answer

My institution does what it can to make **having children** and the tenure-track compatible.

1	2	3	4	5	6	7
Not applicable/ I don't know	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Decline to answer

My institution does what it can to make **raising children** and the tenure-track compatible.

1	2	3	4	5	6	7
Not applicable/ I don't know	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Decline to answer

My departmental colleagues do what they can to make **having children** and the tenure-track compatible.

1	2	3	4	5	6	7
Not applicable/ I don't know	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Decline to answer

My departmental colleagues do what they can to make **raising children** and the tenure-track compatible.

1	2	3	4	5	6	7
Not applicable/ I don't know	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Decline to answer

My colleagues are respectful of my efforts to balance work and home responsibilities.

1	2	3	4	5	6	7
Not applicable/ I don't know	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Decline to answer

58. Please indicate your level of satisfaction or dissatisfaction with the following aspects of your workplace:

The interest senior faculty take in your professional development.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

Your opportunities to collaborate with senior faculty.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The amount of **professional** interaction you have with senior colleagues in your department.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The amount of **personal** interaction you have with senior colleagues in your department.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The amount of **professional** interaction you have with junior colleagues in your department.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The amount of **personal** interaction you have with junior colleagues in your department.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

How well you "fit" , (e.g., your sense of belonging, your comfort level) in your department.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

The intellectual vitality of the senior colleagues in your department.

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

59. Please indicate your level of agreement or disagreement with the following statement:
On a whole, my institution is collegial.

1	2	3	4	5	6	7
Not applicable/ I don't know	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Decline to answer

60. Please indicate your level of agreement or disagreement with the following statements:
On a whole, I receive fair treatment from my colleagues regardless of my:

1	2	3	4	5	6	7
Not applicable/ I don't know	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Decline to answer

a) **Gender**

1	2	3	4	5	6	7
Not applicable/ I don't know	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Decline to answer

b) **Race/ethnicity**

1	2	3	4	5	6	7
Not applicable/ I don't know	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Decline to answer

c) Sexual orientation

1	2	3	4	5	6	7
Not applicable/ I don't know	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Decline to answer

61. Finally, we ask you to make some overall assessments about your department and your institution as a place to work.
    Please check the two (and only two) ***best aspects*** about working at your institution.
    - o Quality of colleagues
    - o Support of colleagues
    - o Opportunities to collaborate with colleagues
    - o Quality of graduate students
    - o Quality of undergraduate students
    - o Quality of facilities
    - o Support for research/creative work (e.g., leave)
    - o Support for teaching
    - o Support for professional development
    - o Assistance for grant proposals
    - o Childcare policies/practices
    - o Availability/quality of childcare facilities
    - o Spousal/partner hiring program
    - o Compensation
    - o Geographic location
    - o Diversity
    - o Presence of others like me
    - o My sense of "fit" here
    - o Protection from service/assignments
    - o Commute
    - o Cost of living
    - o Research/creative work requirements for tenure
    - o Teaching load
    - o Tenure requirements in general
    - o Tenure criteria clarity
    - o Tenure process clarity
    - o Manageable or no pressure to perform
    - o Academic freedom
    - o There are no positive aspects
    - o Decline to answer
    - o Other, please specify

62. Please check two (and only two) ***worst aspects*** about working at your institution
    - o Quality of colleagues
    - o Support of colleagues
    - o Opportunities to collaborate with colleagues
    - o Quality of graduate students

- o Quality of undergraduate students
- o Quality of facilities
- o Support for research/creative work (e.g., leave)
- o Support for teaching
- o Support for professional development
- o Assistance for grant proposals
- o Childcare policies/practices
- o Availability/quality of childcare facilities
- o Spousal/partner hiring program
- o Compensation
- o Geographic location
- o Diversity
- o Presence of others like me
- o My sense of "fit" here
- o Protection from service/assignments
- o Commute
- o Cost of living
- o Research/creative work requirements for tenure
- o Teaching load
- o Tenure requirements in general
- o Tenure criteria clarity
- o Tenure process clarity
- o Manageable or no pressure to perform
- o Academic freedom
- o There are no positive aspects
- o Decline to answer
- o Other, please specify

63. All things considered, how satisfied or dissatisfied are you with your **_department_** as a place to work

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

64. All things considered, how satisfied or dissatisfied are you with your **_institution_** as a place to work

1	2	3	4	5	6	7
Not applicable/ I don't know	Very satisfied	Satisfied	Neither Satisfied nor dissatisfied	Dissatisfied	Very dissatisfied	Decline to answer

65. Assuming you achieve tenure, how long do you plan to remain at your institution?
- o For the rest of my career
- o For the foreseeable future
- o I haven't thought that far ahead
- o Not applicable

    o Decline to answer
    o No more than 5 years after earning tenure (Why?)

66. Please indicate your level of agreement or disagreement with the following statement:
If I could do it over, I would again choose to work at this institution

1	2	3	4	5	6	7
Not applicable/ I don't know	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Decline to answer

67. If a candidate for a tenure-track faculty position asked you about your ***department*** as a place to work, would you:
    o Strongly recommend your department as a place to work
    o Recommend your department as a place to work
    o Not recommend your department as a place to work
    o Decline to answer

68. How do you rate your ***institution*** as a place for junior faculty to work?
    o Great
    o Good
    o So-so
    o Bad
    o Awful
    o Decline to answer

69. Please use the space below to tell us the number one thing that you, personally, feel your institution could do to improve the workplace.

70. Please use the space below to elaborate on any of the questions in the survey that you feel require further comment/explanation or to discuss any aspect of junior faculty/pre-tenure employment not covered, or covered insufficiently, in the survey.

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AWARDS and GRANTS
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Research and Creative Grant Award Recipient, Syracuse University, 2009
Travel Award Recipient, 3rd Conference on Understanding Interventions, 2009
Future Professoriate Program Associate, Syracuse Women in Science & Engineering, 2008-10
Woman of Distinction Award Nominee, Syracuse University, 2008
Teaching Fellow, Syracuse University, 2007-2010
Outstanding Teaching Assistant, Syracuse University, 2007
Future Professoriate Program, Syracuse University, 2005-2009
Joan N. Burstyn Endowed Fund for Collaborative Research in Education Award Recipient, 2006
GK-12 Fellow, National Science Foundation, 2003 - 2004
Teaching Assistantship Award, Syracuse University, 2004 - 2005
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