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Work-Life Balance of Tenured and Tenure-Track Women Engineering Professors

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Walden University
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Abstract

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MEd, University of La Verne, 2004

BS, California State University, Long Beach, 1995

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Balancing the needs of family with career ambitions is often challenging for women who pursue science, technology, engineering, or mathematics (STEM) careers, particularly in academia. In these male-dominated workplaces, few incentives exist for women who decide to manage both work and family. In this basic qualitative research study, a modified approach combining in-depth interviewing with life-history interviewing was used to examine the work-life balance experiences of 12 tenured and tenure-track women engineering faculty who have children. The research question addressed participants' perceptions of engineering academia and experiences regarding family formation, child-raising, and the tenure process. Data were analyzed using the constant comparison method. The conceptual lens consisted of identity formation, feminine ethic of care, procedural knowing, and social learning. Four themes or key findings surfaced from this study: Participants experienced gender stereotyping in engineering academia, participants recognized overlap between the tenure and biological clocks, participants expressed a default arrangement in assuming the burden of childcare, and participants revealed that work-life balance is a false concept. The most significant finding was that the notion of work-life balance was inconsistent with participants' experiences with managing childcare and career; they described their experiences to be more about work-life integration. Implications for positive social change include improving gender diversity and the representation of women in engineering academia. Senior leaders and administrators at institutions of higher education may use study findings, for instance, to undertake program reform to recruit more women into engineering academia.

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Dedication

I dedicate my dissertation to my family. My mother, Isabel Le, who fled Vietnam during the downfall of Saigon with her children in tow. I remember her strong arms surrounding me as we sat aboard a barge in the open sea, rescued 7 days later by the U.S.S. Midway. My mother is strength, courage, love, and compassion. My husband, Gregory Gossage, is my source of unyielding support. He takes care of our sons and keeps our house in order; I'm thankful for his unwavering care. My sisters, AnneMarie Balmeo and Mimi Vogel, have helped me, too. Thanks, especially to AnneMarie and my mother who have looked after my sons whenever I'm at work or away at conferences.

In completing my doctoral journey, I have thought that perhaps people will think I'm more intelligent and competent for having these three letters, PhD, after my name. But I thought deeply about what it really meant for me. The PhD is worth much more than a boost to my professional status or career advancement. I'm the first in my family to go to college, so the PhD symbolizes the struggles of my mother who worked all her life to give me and my sisters a better life. It reflects the optimism of my sisters who cheer me on, and the support of my husband, who keeps me grounded. For my sons, Aiden and Luke, it shows them that mothers can also have careers; and that all things are possible with hard work and dedication. My PhD is a reflection of the collective experiences of many. My PhD does not belong to me alone; it also belongs to my family.

Acknowledgments

My sincerest thanks to Dr. Alice Eichholz, my faculty mentor who served as chair of my dissertation committee. Beginning with the prospectus and throughout the proposal and dissertation process, she has been a pillar of support for me. I was comfortable confiding in her some of my own work-life issues. Her sense of compassion helped me overcome all of it. I also thank Dr. Cheryl Keen, who served as the methodologist and whose keen eyes in the review of my writing helped ease the editing process. She provided the necessary challenges that helped me improve my literary skills and research acumen. Thanks to Mr. Neil Blumberg, my program advisor, whose unyielding patience throughout my doctoral studies cannot be dismissed. He helped me navigate through the maze of forms and policies to complete my coursework and fulfill other doctoral requirements.

No words can describe the participants of this study. I learned from them that the sharing of parenting still holds gender egalitarian beliefs. Just like them, I, too, felt intense pressure to invest more time in my children, and at the same time, I felt reluctant to give up control to my spouse. Perhaps this is a mother's unyielding love for her child. The ways in which each of the participants traversed motherhood and the winding path from doctoral studies to academia left an indelible mark on my own spirit. I am so privileged to have been afforded this special opportunity to meet these exceptionally strong women. They are passionate about their careers, but they love their children even more. I have only profound admiration for these women who shared their life histories, dreams, and future aspirations with me.

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Chapter 1: Introduction to the Study

Women continue to outnumber men in American universities in overall enrollment and educational attainment (U.S. Census Bureau, 2014). The National Center for Education Statistics (2015) reported that of the nation's 20.2 million college students, 11.5 million (or 56.9%) were women. Yet, despite strides in educational equity and a reversal in the gender gap in college enrollment and graduation, women comprise only a quarter of the science, technology, engineering, and mathematics (STEM) workforce (U.S. Census Bureau, 2016). The number of women in engineering is lower than in other STEM fields, according to research findings. In *Women, Minorities, and Persons with Disabilities in Science and Engineering* (National Science Foundation, 2017), the data indicated relatively high participation among women in the biosciences, mathematics, or physical sciences. However, in engineering, men outnumber women, with women comprising about 20% of the total engineering undergraduate student population (Yoder, 2017) and 10% of professional engineers (American Association of Engineering Societies, 2010). As these statistics illustrate, the gender gap remains a persistent issue for women in engineering.

Chapter 1 includes the background, problem statement, purpose of the study, research question, conceptual framework, and nature of the study, including a rationale for the selection of the research design. To eliminate any ambiguity in the interpretation of key concepts, I present the operational definitions of relevant terms. The chapter also includes discussion of the assumptions, scope and delimitations, and limitations of the research. I describe how I preserved participant confidentiality and what measures I took

to mitigate limitations. At the conclusion of Chapter 1, I summarize the main ideas and significance of the study and its implications for positive social change.

Background

In 2011, the American Society for Engineering Education (ASEE) developed a diversity committee designed to increase the prominence of women and minorities in engineering. ASEE (2011) published a statement on diversity and inclusiveness deeming it "essential to enriching educational experiences and innovations that drive the development of creative solutions" (Statement on Diversity and Inclusiveness section, para. 1). In short, ASEE stated that without the participation of diverse communities of people, the products and innovations arising from the technical workforce are likely to be limited to the perspectives of a few. Women's presence in engineering faculties reinforces the idea that engineering is also a field for women. Yet, despite robust advocacy aimed at increasing the participation of women in engineering, there continues to be a shortage of women entering the field of engineering. In *Why So Few*, a publication of the American Association of University Women, Hill, Corbet, and St. Rose (2010) described the small number of women entering STEM fields; overall, women in engineering comprised the smallest proportion of women in the STEM fields.

However, the acute underrepresentation of women in engineering is not simply an issue of recruitment; it may also have to do with retention of female engineering students. Fox (2011) reported that women faculty have the potential to significantly increase the academic success and retention of women engineering students by virtue of their role as mentors. Based on a National Academies (2010) report, women comprised 32% of new

STEM PhDs but represented only 18% of STEM tenured and tenure-track applicants. The National Science Foundation's (NSF) *Survey of Earned Doctorates* (2017), a national dataset that includes longitudinal tracking of PhDs across the disciplines until the age of 27, revealed that while women earned a substantial proportion (46%) of all doctorates awarded to U.S. citizens, women's representation in physical and earth sciences, mathematics and computer sciences, and engineering was still relatively low.

In 2014, only 23% of engineering doctorates were earned by women, as compared to the life sciences where women represented close to 50% of earned doctorates (NSF, 2017). NSF (2017) published a report on the occupational trends of STEM doctorate recipients, noting that less than 50% of all STEM doctorate recipients indicated that their primary occupation would be in academia. Among women who earned engineering doctorates, only 15.7% held tenured or tenure-track engineering faculty positions (Yoder, 2017). When examining the participation of women doctorate recipients in relation to their employment in academia, NSF data revealed that women were less inclined than men to identify faculty teaching as their primary occupation (NSF, 2017). By contrast, appointments in the humanities represented 80% of all academic appointments, indicating that humanities graduates were more likely to pursue a career in teaching. Overall, women represented about 57% of non-STEM academic positions (NSF, 2017).

Reflecting the continued decrease in the overall participation of women in STEM academic fields, the total number of STEM academic appointments declined by 5% from 2004 to 2014. NSF (2017) data also revealed a retention gap between women faculty with

children and those without children. Women continue, therefore, to be underrepresented in STEM academia relative to their representation as STEM doctorate recipients.

The findings of this study augment the data presented in existing literature, such as Mason, Wolfinger, and Goulden's (2013) study which included an examination of the academic careers of both men and women, including graduate students and postdoctoral fellows. This study is significant in that it enhances understanding of the impact of work-life balance on women's career ambitions and how gendered norms are embedded in the ways that women negotiate family formation and academic life. In addition, this study provides a perspective not addressed in the current literature by exploring the experiences of women engineering professors who are currently seeking or have attained tenure and promotion while raising children.

Problem Statement

A common hurdle, affecting both men and women in the United States, is work-life balance; it is one of the factors that has sway over a person's professional and career development (U.S. Department of Labor, 2015). In the Family and Medical Leave Act of 1993, the U.S. Department of Labor recognized that women often assumed the primary responsibility for family caretaking. Balancing the needs of family with career ambitions can be challenging for women who pursue science careers (Pain, 2015). With men dominating the engineering workplace, including engineering academia, few incentives exist for women who decide to manage both work and family. Despite studies that have shown that women applicants have a better chance of obtaining tenured and tenure-track positions compared to their male counterparts (Williams & Ceci, 2015), few women

pursue STEM academia, and even fewer are found in engineering academia. Building on data presented in the existing literature (e.g., Mason et al., 2013), I examined the experiences of women engineering professors who have children to understand the impact on work-life balance and how gendered norms are embedded in the ways that women negotiate family and academic life. Based on my review of the literature, the study topic is not yet addressed in the current literature. This study, therefore, provides a unique perspective by exploring the experiences of women engineering professors who are currently seeking tenure or who attained tenure while raising children.

Purpose of the Study

The purpose of this study was to examine the work-life balance experiences of tenured and tenure-track women engineering professors who have children. The dearth of women engineering professors, along with the current literature relating women's work-life balance challenges to the shortage of women in the STEM professions (National Academies, 2010), suggests that there may be ways to mitigate some of these challenges. Using data from interviews of 12 women engineering professors, I sought to provide more understanding of how work-life balance is a fundamental structure of women engineering professors' experience. Findings may provide higher education administrators with findings that can be used to substantiate efforts to support women in tenured and tenure-track engineering positions. In addition, the study might catalyze discussions that increase awareness of women's underrepresentation in engineering academia.

Research Question

The research question for this basic qualitative study was, What are the experiences of tenured and tenure-track women engineering professors regarding family formation, child-raising, and the tenure process?

Conceptual Framework

The conceptual framework for this study incorporated an array of theories. Gilligan's (1982) feminine ethic of care was germane in advancing an understanding of the study phenomenon, women's underrepresentation in engineering academia. Because of the wide-ranging nature of feminist theory, which encompasses a multitude of themes including discrimination, objectification, oppression, and stereotyping (Steele, 1997), I restricted the conceptual framework for this study to women's cognitive development. In this sense, an epistemological perspective was relevant. Hence, women's development theory, specifically *women's ways of knowing* (Belenky, Clinchy, Goldberger, & Tarule, 1986), which concerns the cognitive development of women in terms of identity and intellectual development, was particularly significant in refining the conceptual framework.

In an effort to blend and link theories, I also considered the social-cultural and psychosocial influences that describe how individuals learn; an understanding of cognitive processes (attention, retention, reproduction, and motivation), I surmised, would yield a deeper understanding of women's motivation underlying the career decisions they made for themselves. Hence, Bandura's (1977) social learning theory, which focuses on the mental features of learning, was relevant. Bandura explained that

individuals do not simply duplicate an observed behavior; rather, there exists a mediational process that occurs prior to the imitation of observed behavior.

Because social learning theory (Bandura, 1977) does not fully explain all types of behavior, particularly when there was absence of a role model—as is the case in the male-dominated engineering field where female role models are scarce (National Society of Professional Engineers, 2015; U.S. Department of Labor, 2015)—it was important to understand the stages of life when individual uniqueness and characteristics are achieved. This developmental trajectory is referred to as the establishment of a reputation (Bandura, 1977) and was especially useful in understanding how women approach male-dominated careers. Erikson's (1950) identity formation theory explains how individuals see themselves in relation to others and themselves. Erikson's view of the individual includes both an awareness of uniqueness from others as well as one of group affiliation. In evaluating the experiences of the individual, a multitude of experiences that the individual accumulates contributes to the individual as a whole person (Erikson, 1950). In this study, the concept of identity formation helped to further an understanding of the unique intersectionality between women as engineering professors and women as mothers.

Feminist theory (Gilligan, 1982), women's development theory (Belenky et al., 1986), social learning theory (Bandura, 1977), and identity formation theory (Erikson, 1950) together offered substantive background for the development of this study's conceptual framework. I used the conceptual framework to develop the study's research

question. Answering the research question yielded insight about the experiences of women engineering professors who also held responsibilities for childcare.

Nature of the Study

I drew from a nonpositivist perspective in designing the study. I used the basic qualitative study approach, employing interviews and observations to answer the research question and draw conclusions. Rooted philosophically in constructionism and commonly used in educational research, the basic qualitative study approach is used by researchers to examine people's interpretation of experiences and the meaning they attribute to such experiences (Merriam & Tisdell, 2016). In the basic qualitative study approach, data are collected through the interview process. For this study, I employed a modified version of Seidman's (2006) three-stage interviewing technique. I used a nonrandom, purposeful sample of participants because the study involved a marginalized population—in this case, tenured and tenure-track women engineering professors who have children. Owing to the descriptive and interpretive nature of this research approach, no priori codes (Saldaña, 2009) were used; instead, codes were developed after the first interview when the context of participants' experiences was established. Data analysis involved identification of recurring themes. Data interpretation arose from my understanding of the beliefs and theories that informed the research. Using the study findings, I was able to recommend strategies in Chapter 5 to improve educational practice and simultaneously advance the condition of a group of people (in this case, the representation of women in engineering academia).

Operational Definitions

I used the following operational definitions in the study:

Assistant professor: Appointments to this rank are designated to faculty who hold a terminal degree appropriate to the field (or who brought to the institution professional experience deemed the equivalent of the terminal degree). New faculty appointments are commonly made at this rank.

Associate professor: Upon receiving tenure, an assistant professor will be promoted to the rank of associate professor. An individual appointed to this rank is often required to have at least six years of full-time college teaching experience (or equivalent). This individual typically will have demonstrated substantial professional achievement in the areas of teaching, research, and service. An individual may be hired at this rank without tenure and deemed tenure-track and expected to qualify for tenure. New faculty appointments may be made at this rank under circumstances deemed appropriate by academic leadership.

Professor: An individual appointed to this rank, in addition to the degree credentials required of an assistant professor, must have at least 10 years of full-time college teaching experience (or the equivalent). In that time, this individual must have achieved professional distinction in the areas of teaching, research, and service. New faculty appointments may be made at this rank under circumstances deemed appropriate by the dean, the provost, and the president.

Tenured: Tenured individuals have attained this status as the result of appropriate action by recommendations of the department and the dean of the college. Tenured faculty are assured continued reappointment by institution year after year.

Tenure-track: A tenure-track appointment carries a probationary period leading to tenure. In the time period prior to the awarding of tenure, regular tenure-track faculty are typically appointed or reappointed for one, two, or three academic years.

Assumptions

I identified three assumptions for this study. The first assumption was that participants would provide authentic responses to the interview questions. To create a climate where participants can candidly and openly share their personal experiences, confidentiality was preserved, and participants were considered volunteers who may withdraw from the study at any time without any ramifications. The second assumption was that the inclusion criteria for the study were appropriate, and participants would report similar experiences of the phenomenon. Thirdly, because participants were women engineering professors, it was also assumed that the manner in which they provided responses would demonstrate both deliberation and concern for the issue of women's under-representation in engineering academia, and that they would have a genuine interest in participating in study.

Scope and Delimitations

This basic qualitative research study was designed to explore the experiences of tenured and tenure-track women engineering professors in the United States. The scope of this study was established by the research question and the interviewing approach,

which were both developed specifically for a unique population of tenured and tenure-track women engineering professors with children. Due to the overall scarcity of tenured and tenure-track women engineering faculty, this study was delimited by the under-representation of individuals in the target population. Male academics, women academics in disciplines outside of engineering, and women engineering academics who do not hold a tenure rank or do not have children were excluded in this study.

Limitations

While the interview approach presented a limitation—given that I was the only interviewer, thereby introducing the possibility of bias—the conventional practice in qualitative research expects the researcher to bracket of his/her biases, mitigating the potentially adverse effects of preconceptions (Patton, 2015). The small sample size also limited generalizability. The results of the study will have limited generalizability to other populations of women in engineering academia, such as those without tenure. Because participants resided in various geographic locations across the country, there was a limitation in the transferability of the findings to particular locations. Finally, given the self-selection of participants, it was anticipated that participants would include women engineering faculty who experienced concerns about the ability to attain tenure as a result of work-life balance challenges as opposed to those who had no such concerns.

Significance

Having reviewed over 30 years of research on gender stereotypes and women-in-engineering outreach, recruitment, and retention, Mattis (2007) grappled with the dilemma of why so few women become engineers; the scarcity of women in the fastest

growing and lucrative field continues to be a perplexing question. Mattis reported that parents were the most influential factor in high school girls' career choices, next to friends, teachers, siblings, and school counselors:

> Girls do not understand what a career in engineering looks like and why they should consider it as a career option because the people that influence them—teachers, school counselors, parents, peers and the media—do not themselves have this understanding. (Mattis, 2007, p. 339-340)

Not unique to the body of literature involving women-in-engineering outreach program, the mainstay of Mattis's research focused on the landscape of K-12 STEM education; yet research involving the experiences of professional women engineers, including women in engineering academia, continues to be sparse. Other factors that contribute to women's under-representation in engineering include influences on the career trajectory of girls during the formative school years, the impacts of gender bias in the workplace, the career-stalling effects on women with children, socio-cultural factors, gender stereotypes, and stereotype threat (Steele, 1997; Van der Lee & Ellemers, 2015; Xu & Martin, 2011). My hope in this study was to improve women's economic worth by addressing women's under-representation in engineering. This study offered a voice to women engineering professors so that they can share their experiences—including the storied details of work-life balance and other constraints that continue steer women away from engineering—and inspire other women who pursue similar career pathways. Senior leaders and administrators at institutions of higher education wanting to recruit more women in academia have a vested interest in this study. This study's results may provide the initial

motivation for program reform involving positive social change with respect to improving gender diversity in the historically male-dominated field of engineering.

Summary

Earning more college degrees than men, women represent a sizeable economic force (NSF, 2017; U.S. Department of Labor, 2015). Yet the gender gap in engineering persists, more so than in any other profession. While women comprise nearly half of the U.S. workforce (U.S. Census Bureau, 2016), they continue to be under-represented in the engineering workforce, representing no more than 14% of women employed in engineering industry (U.S. Department of Labor, 2015) and only 10.7% of professional engineers (National Society of Professional Engineers, 2015). Women currently represent 16.9% of tenured and tenure-track engineering faculty; and by level, they represent 24.3% of assistant professors, 19.5% of associate professors, and 11.8% of full professors (Yoder, 2017). Women's presence in the engineering faculty may reinforce the idea that engineering is also a field where women can be successful.

In this basic qualitative study, 12 women engineering professors were interviewed to collect their experiences of the academic environment and perspectives on how work-life balance and childcare affect their capacity to attain tenure. Building on the research question—which explores family formation, child-raising, and the tenure process—the conceptual framework was presented in context to strengthen an understanding of traditional theories, concepts, and seminal inquiries that shaped the study approach and guided the development of the study design. In Chapter 1, I provided an overview of the problem of women's under-representation in engineering and background information

and statistics on women's status in higher education and the labor workforce. The research question, assumptions, scope and delimitations, limitations, and the significance of the study were introduced to construct an understanding of the intended outcomes for this study. This laid the foundation for topics covered in Chapter 2 where I presented the conceptual framework—drawn from four traditional theorists, Erikson (1950), Gilligan (1982), Belenky et al. (1986), and Bandura (1977)—and the literature review. In the literature review, I offered a critique of studies involving three topical areas, women in STEM academia, women and the academic tenure process, and women and work-life balance.

Chapter 2: Literature Review

Among scholars studying issues related to women in STEM fields, certain topics have been of more interest than others. Hill et al. (2010) focused on the leaky pipeline of women in the STEM fields. The recurrent theme in women-in-engineering research has been the examination of the student experience, either of children participating in precollege (K-12) engineering outreach or young adults pursuing a college degree (Mattis, 2007). Some researchers (Feyerherm & Vick, 2005; Fouad, 2014; Malu, Soe, & Yakura, 2004; Powell, Bagilhole & Dainty, 2009; Yonemura & Wilson, 2016) have examined the culture of the engineering workplace and climate for women who are employed as professional engineers. Yet few researchers have examined the higher education climate for women engineering faculty, based on my review of the literature. Currently, there are few published research studies whose authors have explored the work-life balance experiences of tenured or tenure-track women engineering faculty who have attained tenure while managing childcare. Studies that focused on the women professoriate in STEM fields other than engineering are juxtaposed against studies of women in STEM industry. Issues surrounding work-life balance represent the greater part of this study's literature review.

Addressing the work-life balance conundrum and its impact on women in engineering academia, the purpose of this basic qualitative study was to understand how the experiences of women engineering faculty with children and their issues with work-life balance impinge upon the attainment of academic tenure. I explored the educational experiences, perceptions of engineering academic climate, and work-life balance

experiences of women engineering faculty. The review of literature includes contemporary research studies. I categorized articles under three topical areas: (a) women in STEM academia, (b) women and the academic tenure process, and (c) women and work-life balance. Regarding women in STEM academia, I analyzed over three dozen articles, ranging from double-blind experiments that revealed gender bias against women in STEM to action-oriented studies exploring faculty recruitment and a large institutional level survey of doctorate degrees awarded to women. Among the literature that I selected on the topic of women and the academic tenure process, over two dozen articles described various studies involving women and academic tenure. The study that most closely aligned with my study involved a case study about tenure-track nursing faculty (Poronsky, Doering, Mkandawire-Valhmu, & Rice, 2012). Last, regarding women and work-life balance, I analyzed about a dozen articles describing various studies and approaches related to work-life balance.

This chapter is organized into four sections: an in-depth description of the literature search strategy; the conceptual framework describing aspects of traditional theories relevant to this study—including Gilligan's (1982) feminine ethic of care, Bandura's (1977) social learning theory, Belenky et al.'s (1986) perspectives on women's ways of knowing, and Erikson's (1950) identity formation theory—and an analysis of current empirical literature. I end the chapter with a summary of the major themes and findings from the review of literature, along with an explanation as to how this study was intended to fill the gap in the literature.

Literature Search Strategy

A review of a broad range of peer-reviewed full-text articles—in the areas of engineering education, psychology, sociology, and women and gender studies, including those based on feminist theory—revealed a gap in the literature on tenured and tenure-track women engineering faculty who have children. In total, I conducted 16 literature searches of articles. An initial search, using Academic Search Complete and applying the search terms and Boolean phrases *women*, *engineer*, and *faculty*, yielded only a handful of articles. I expanded the search to include other databases, such as Google Scholar, as well as discipline-specific data mining sites—such as the ASEE data mining tool and the Women in Engineering ProActive Network (WEPAN) Knowledge Center's database tools and digital library—and I broadened the keywords to include *women*, *STEM*, and *faculty*. This process yielded over two dozen articles. Among these articles were studies on women faculty, mentoring, and intervention strategies for increasing STEM faculty gender diversity.

With the search yielding only one article on family-friendly practices for scientists and another on work-life balance of women in STEM, I expanded the search to include the keywords *work-life balance*, *STEM*, and *faculty* or *professor*. A search using the keyword combination *work-life balance* and *faculty* yielded a total of 18 relevant articles. Interestingly, even when the term *STEM* was excluded, the majority of articles on *work-life balance* were associated with STEM careers.

Separate searches, involving the keywords *tenure process* and *work-life balance*, provided additional articles. While the search resulted in hundreds of articles on the topic

of work-life balance, it yielded few articles about the work-life balance experiences of tenured women faculty and even fewer about the experiences of tenured women engineering faculty. With searches recovering fewer than a dozen articles on tenured women in STEM academia and no current studies specifically focusing on tenured or tenure-track women engineering faculty who have children, I performed forward and backward citation searches from a select number of articles, including those gleaned from the WEPAN digital library. Although these searches yielded better results than did multiple keyword searches—with over three dozen articles selected to support the discussion on women in STEM and a dozen related to women and the tenure process—I expected that more recently published literature would emerge during the course of this study.

Conceptual Framework

The phenomenon of underrepresentation of women in engineering has been investigated through various constructs, including culture and privilege, organizational theory, human capital, and professional development and mentoring. Gilligan's (1982) framework on feminism, the reactionary ideology based on power struggle, women's rights, and gender equality provided the contextual lens for this study. In discussing gender equality, it was also important to gain an understanding of women's development theory. Thus, I incorporated Belenky et al.'s (1986) five stages in women's ways of knowing, specifically the notions of *separate knowing* and *connected knowing* in the procedural knowledge stage, to offer a conceptual distinction from Gilligan's feminine ethic of care. To be able to articulate how women learn in the social context, I drew from

Bandura's (1977) social learning theory which posits how people learn from one another through observation, imitation, and modeling. Last, I incorporated Erikson's (1950) identity formation theory, which places greater emphasis on the social context and influence of society on the development of the individual.

Erikson: Identity Versus Role Confusion

As an important aside, Erikson's (1950) psychosocial theory encompasses eight stages of identity development from birth to adulthood; however, for this study, I did not limit his theory to its original representation. Erikson's earlier concept of identity formation—as it relates to how life priorities affect value priorities, occupational status, and lifestyle—was an aspect that I discussed in the context of differentiated facets of a person's identity, such as occupational identity and professional reputation. As a Freudian ego-psychologist, Erikson accepted the view that male and female differences in personality were a result of biology. Yet Erikson also relied on the theory of psychosocial development (Erikson, Paul, Heider, & Gardner, 1959), which envisioned eight discrete stages though which a person traverses and resolves conflict between psychological needs and society's needs at each stage to advance to the next stage. These eight stages are trust versus mistrust, autonomy versus shame and doubt, initiative versus guilt, industry versus inferiority, identity versus role confusion, intimacy versus isolation, generativity versus stagnation, and integrity versus despair. The stage of *identity versus role confusion* was most articulated in contemporary research studies on identity and the sociocultural context of career choice for women, and it was this particular element of Erikson's theory that offered a useful context through which women's career

development could be examined in this study. It is at this stage, occurring during the adolescent years, when a person begins to develop independence and a sense of self (Erikson, 1950). This *self* or *ego identity* (Erikson et al., 1959) refers to the sentient aspect of a person's being that is developed and perpetually changes through daily human interaction and new experiences.

Gilligan: Feminine Ethic of Care

In trying to understand why women continue to be under-represented in engineering academia, the feminine ethic of care (Gilligan, 1982), the perspectives on women's ways of knowing (Belenky et al., 1986), social learning theory (Bandura, 1977), and identity formation theory (Erikson, 1950) became relevant; together, they pointed to social-cultural and psycho-social influences that affect the career choices that women make for themselves. Bandura's (1986) social cognitive model, in particular the "triadic reciprocality" (p. 18), suggested a compelling argument for why there are so few women engineers. What Bandura (1977) described as the constructs of the *environment*, *self*, and *behavior* can be considered in the context of self-reinforcing factors that steer women away from engineering. In this construction, the environment I referred to is the "chilly" climate of engineering as being male-dominated (Malu et al., 2004; Yonemura & Wilson, 2016), while the component of *self* referred to academic self-confidence (faith in one's ability based on positive experiences), and self-efficacy (confidence of one's ability for achieving a specific task). Bandura (1986) posited that the aspect of *behavior* is characterized by self-regulated strategies, such as help-seeking, effort, and critical thinking behaviors, important in the decision-making process.

Given the history that casts women as emotional beings, bereft of logic and dependent on men for guidance, feminists are the foremost champions for asserting women's need for personal agency and self-determination (Allen, 2016). Notable among American feminists is Gilligan who believed that women were socialized from the time of childhood to experience the needs and feelings of others. Gilligan's (1982) theory emphasized the relationship between the individual and others as evolving from a sense of caring. Considering alignment with feminism, it implied that when one becomes more concerned with the condition of others, one has reached a higher level of morality.

Gilligan's (1982) theory was a repudiation of traditional moral theory—a rejection of Freud's (1905) theory of psychosexual development based on the assumption that Freud (1905) viewed women as morally inferior—and a censure of Kohlberg's (1976) moral development theory as being male-biased; it recognized that men and women perceive the social world differently. Gilligan (1982) viewed women as being more naturally inclined toward a nurturing persona, due to the socio-cultural values and virtues that have been connected to femininity, and she attempted to explain women's subordination as a result of patriarchal society's failure in valuing women's perspective, specifically from a care-focused ethic. Gilligan (1982) maintained that women's moral development is distinct from that of men as it evolved from an orientation based on responsibilities and connectedness; while men's orientation comes from an attention to autonomy and separateness. Gilligan's thinking came from the supposition that women are more inclined to value an ethics of compassion and care than would men, a stark distinction from the common view that engineering as a profession is devoid of care and

defined by male-gendered social constructs. From this notion was borne the stereotype that women are not fit for a career in engineering. In this study, Gilligan's theory helped guide the interview questions, with anticipation that the results will shed light on the work-life balance of women in engineering academia. Perhaps the study results will help determine whether a rationale can be found in the feminine ethic of care with respect to women's self-determination for pursuing non-traditional career roles.

Belenky, Clinchy, Goldberger, and Tarule: Women's Ways of Knowing

Prior to the feminist movement, few models of behavior were constructed based on samples that involved women (Ball, 2010). In the quest for new knowledge, many of the prominent social and behavioral investigators were themselves men (Bandura, 1963, 1977; Erikson, 1950; Skinner, 1938). Bridled by historical expectations of male and female social roles, the development of women's place in society was based on the perspectives of men. From the assumption that women think and behave differently than men, women's voices became essential in the reconstruction of theory (Ball, 2010). As has been the case historically—where research was commonly undertaken by men, and the participants under study were predominantly male—and like Gilligan (1982), Belenky et al. (1986) extended Perry's (1970) theory of intellectual and ethical development for the reason that his study of college student development used an all-male sample. In response, an analogous study involving an all-female sample was developed by Belenky et al. (1986), and the results of the study formed the basis of a new theory of knowledge. Deemed women's ways of knowing, the theory describes five different positions along the spectrum of women's epistemological development: silence,

received knowing, subjective knowing, procedural knowing (separate and connected), and constructed knowing. To gain a better understanding of women's lackluster participation in engineering academia, considered a male domain, the theory of women's ways of knowing established a rationale for differences between men and women's epistemological development. Through this rationale, social-cultural and epistemological development can be envisioned from the perspective of women.

In mapping the current literature on women in engineering academia against traditional theory, an appraisal of feminist theory sets the stage. The study conducted by Beddoes and Borrego (2011) represented the only article I found that advanced the use of feminist theory for the purpose of promoting gender equity in engineering. The researchers maintained that policies and strategies were insufficient to increase the prominence of women in engineering and asserted that feminist theory offers a rationale for why the most well thought out women-in-engineering promotion efforts may in fact reinforce the same conditions that persist in male-dominated environments. They rejected gender as a dichotomous construct—the view that an individual is either male or female—and recognized the intersectionality of gender identity with engineering identity. Matusovich, Barry, Meyers, and Louis (2011) also sought to understand the formation of a professional identity and recognized this identity as being separate from an engineering identity. Also applying the multiple-identity framework (Brown, Reveles, & Kelly, 2005; Gee, 2000; Jackson, 1981), another study by Tate and Lin (2005) viewed gender more holistically and sought to understand engineering beyond a gender-segregated discipline. In order to gain a deeper understanding of the experiences of women of color engineering

students, Tate and Lin examined how gender identity intersects with racial identity. They discovered that women of color persisted in engineering by developing multiple identities in order to adapt to various environments; and in this instance, the notions of identity and intellectual development were drawn from the perspectives on the theory of women's ways of knowing (Belenky et al., 1986).

Bandura: Personal Agency and Efficacy Beliefs

Blending the perspectives of cognitive and behaviorist psychology, Bandura (1977) advanced a theory of *reciprocal determinism* that expressed how a person behaves in relation to personal factors and the environment, such that the person and environment have mutual effects on each other. Specifically, Bandura believed a person's behavior impacts the environment and in turn, the environment influences a person's behavior. Through this paradigm of mutual influence, a person's personality can change by removing or replacing original influences experienced by the person during earlier years. Operating from the perspective that knowledge is acquired through observations—from which an idea materializes and similar or new behaviors emerge—Bandura (1977) did not subscribe to the behaviorist idea that a person's behavior impinges on a system of reinforcement or punishment. Instead, he adopted the idea that personality is ever-changing due to interplay between the environment, personal factors, and behavior. He incorporated aspects of memory, motivation, and attention in his concept of observational learning; hence, his theory extends across both behavioral and cognitive frameworks.

The ability to adapt is a self-regulatory mechanism that aligned with Bandura's (1977) concepts of personal agency and efficacy beliefs. Bandura believed that people's

career choices and development, in particular career preparation and resilience, are influenced by how strongly they believe in their efficacy. Inadequate capacity to exercise personal agency may result in gender inequality in the workforce (Bandura, 1977). The ability to transform personal choices into desired outcomes is affected by many factors, such as cultural norms, expectations of men and women's role in society, decision-making regarding family formation, gender stereotypes, and implicit bias. Bandura (1977) suggested that personal agency is requisite for achieving a scholarly reputation and is likely manifest in those who have developed a professional identity. Professional identity referred to the distinct sense of uniqueness expressed in Erikson's (1950) identity formation theory.

Rationale for Conceptual Framework

The challenge that women face in developing a professional identity relates to the philosophical discourse on feminist theory (Gilligan, 1982) which recognizes gender inequality in terms of discrimination, stereotyping, and oppression based on men's flawed perception of women. This discourse also tested the relevancy of feminist theory on the body of research regarding workplace gender inequality. Identity development can also be explored with respect to its relationship to cognitive development. Since maturation of epistemological thinking is essential to identity formation, a person's cognitive development influences the development of identity. Delay in identity formation hinders a person's ability to establish life goals. How women perceive themselves and their position in the world is influenced by various and nested identities connected to ethnicity, race, class, and other constructs. These identities can be

envisioned in terms of the framework of women's development theory and the perspectives on women's ways of knowing (Belenky et al., 1986). Among the five ways of knowing, procedural knowledge and constructed knowledge were most relevant to the discussion of women in STEM academia. Because women STEM academics are situated in a male-dominated culture, their identities may most align with the separate knowing mode of procedural knowledge*;* this position is expressed in terms of adversarial and critical analysis, traits that are commonly associated with men. Moreover, women in the position of *constructed knowledge* tended to experience solitude and a sense of disappointment due to lack of support. An understanding of these theories, concepts, and seminal inquiries shaped the study approach and research questions and guided the development of the study design.

Literature Review Related to Key Concepts

Women's increased participation in the workforce has contributed to dramatic changes in the day-to-day responsibilities of family life (Vandello, Hettinger, Bosson, & Siddiqi, 2013). The most recent figures suggested that over 70% of U.S. women (irrespective of marital status) with children under the age of 18 are employed, as compared to 90% of U.S. men (U.S. Department of Labor, 2015). Aside from economic advantages, the rise in women's participation in the workforce has shown increased benefits associated with women's psychological and physical health. Usdansky, Gordon, Wang, and Gluzman (2011) examined the impact of employment among women with infants and found that employment significantly reduced symptoms of depression among women who preferred to be employed or held high-quality jobs. Accordingly, labor force

data (Department of Labor, 2015) indicated that less than 13% of women with children were constantly in and out of employment preceding childbirth and two years subsequent to childbirth. The moderately brief time of unemployment, among women with children, suggested that the employment rate of women in general is higher. Despite the surge in women's representation in the workforce and the economic and health benefits it offers, workforce readiness and equitable representation of women are not evident in the STEM fields; women continue to be under-represented in STEM, and in particular, in engineering (National Society of Professional Engineers, 2015).

Notwithstanding the recognition that employment is a means to reducing gender inequalities, women continue to face hurdles in achieving equitable employment. The condition of the gender pay gap has been rationalized by the fact that men were identified by Okin (1989) to control virtually all major institutions and corporations, with women earning $0.79 for every $1.00 earned by men. Men's domination of the workplace stimulated the dialog about gender stereotypes and implicit bias, the deeply ingrained pervasive attitudes that affect how we behave in an unconscious manner (Allen, 2016). In a poll of Fortune 500 companies, Gladwell (2009) discovered that about 58% of CEOs were about 6 feet in height, and 30% were 6 feet two inches or higher; these CEOs were overwhelmingly white men. Among CEOs in this sample, only 10 were below 5 feet 6 inches; this indicated that short-statured people, as a group, may be more disadvantaged than women or people of color with respect to corporate leadership roles. A passage, excerpted from Gladwell (2009) captured the essence of implicit bias:

> Most of us, in ways that we are not entirely aware of, automatically associate leadership ability with imposing physical stature. We have a sense, in our minds, of what a leader is supposed to look like, and that stereotype is so powerful that when someone fits it, we simply become blind to other considerations. (para 3)

The over-representation of tall white men in corporate leadership roles, as Gladwell (2009) asserted, reinforces our biases and causes us to associate leadership ability with physically tall-statured people. Likewise, the over-representation of men also extends to the STEM fields, where the hegemonic masculine culture of engineering is oft-cited as a leading reason for women's attrition in the field (Morris & Daniel, 2008; Ortiz, Nicholls, & Leonard, 2015; Yonemura & Wilson, 2016). What follows was a discussion of women in STEM, including both survey data and research studies describing various aspects of women's status in STEM academia, industry, and professional practice.

Women in STEM Academia

Examining survey data on university faculty offered a general view of faculty experiences and established the current climate of academic work for women faculty. Eagan et al. (2014) conducted a national survey of college and university faculty. Data from 133 participating institutions and 63 additional institutions comprised the normative national sample. The results (involving 35% of full-time faculty from colleges and 20% from universities) showed that 61.8% of male professors ranked in the high group in terms of scholarly productivity, as compared with 50.5% of female professors. Also focusing on faculty scholarship, Maliniak, Powers, and Walter (2013) discovered indications of sex bias to the extent that there were notable differences in citation and

publication between men and women, and that such differences affected overall success in academia. The study revealed that women were cited in publications less than men.

Other studies also confirmed the existence of gender bias against women in the STEM fields. Handley, Brown, Moss-Racusin, and Smith (2016) used three randomized double-blind experiments to expose gender bias against women in STEM; they concluded that gender bias was more prominent among male faculty than among women faculty. Moss-Racusin, Dovidio, Brescoll, Graham, and Handelsman's (2012) analysis of online comments suggested that men tended to display more negative reactions regarding gender bias than did women. The study conducted by Hill et al. (2010) revealed that women who were successful were less admired than their male counterparts. These findings have serious implications. They suggested that there is reluctance among male faculty, and in some cases institutions of higher education, to acknowledge gender bias even in the face of empirical evidence.

In terms of faculty recruitment, Ceci and Williams (2015) surveyed over 870 faculty members in 371 colleges and universities across the nation and discovered that faculty decision-makers expressed concern over sex bias and opinions about lifestyle choices (i.e., married with children, single without children, etc.) as having influenced hiring decisions. While they discovered that women had an advantage over men in terms of STEM faculty hiring—with survey data revealing faculty preference for hiring women—they dispelled the notion that affirmative hiring practices were involved: "Apparently, academic faculty view quality as the most important determinant of hiring rankings, which suggests that when women scientists are hired in the academy it is

because they are viewed as being equal or superior to male competitors" (p. 6). By contrast, content analyses of evaluation materials used in the ranking of research grant proposals submitted by a national population of early-career scientists, revealed the use of gendered language in preference of male applicants (Van der Lee & Ellemers, 2015). Gender inequality was reported in several studies involving the award of research grants (Bedi, Van Dam, & Munafo, 2012; Lincoln, Pincus, & Leboy, 2011; Pohlhaus, Jiang & Sutton, 2010). Even when grant award rates among women and men were comparable, women were less frequently listed as principal investigators (Lincoln et al., 2011).

Regarding the significance of scholarship, Lincoln, Pincus, Koster, and Leboy (2012) analyzed women's professional awards, as bestowed by 13 different STEM professional societies. They discovered that men won a higher share of scholarly awards in proportion to the number of nominations. Termed the 'Matilda effect,' this study demonstrated that women do not receive equal recognition for comparable efforts. Even in fields such as psychology where gender distribution may be more equal, the 'Matilda effect' exists. Similarly, Vaid and Geraci (2016) found that male psychologists receive more visibility than their female counterparts. Male psychologists are over-represented in professional societies where they serve as journal editors and fellows; hence, male psychologists are recipients of a majority of prestigious awards. Herein, gender parity does not ensure professional parity. In these studies, researchers suggested that attention be given to the gendered structures of status and power in order that women are afforded equal opportunity for developing a professional identity. These studies suggest that the ability to win research grants directly affects the recruitment of women in academia.

To gain insight on how faculty members understand women's under-representation in STEM academia, Beddoes and Pawley (2014) conducted in-depth interviews of 19 tenured and tenure-track STEM faculty members (four men and 15 women). They discovered that the theme of family responsibilities, such as childcare and housework, emerged as prominent. In reporting that work-life balance was more pressing an issue for female faculty who had children and a spouse than for male faculty, participants associated work-life balance with the unequal distribution of family responsibilities; they expressed that women bore the greater burden of family responsibilities. Beddoes and Pawley problematized the discourse of *choice*, and their findings revealed that faculty believed gendered family roles to be the primary reason for women's under-representation in STEM academia, but that such gendered roles were a result of individual choice and not institutional barrier. Beddoes and Pawley (2014) stated that "if men and women faculty are not playing on a level playing field, as prior research demonstrates they are not, decisions need to be understood as more than simply individual choices" (p.1,576).

The study conducted by Poronsky et al. (2012) explored the impact of children on academic women's tenure experience. While the study did not involve women engineering academics, the study's findings are related to the topic of women's work-life balance. Offering an optimistic view of the effects of family-friendly policies and institutional support for mitigating work-life balance issues, the study conducted by Minerick, Wasburn, and Young (2009) involved tenure track women faculty. Recognizing that work-life balance is not an issue specific to women, one of the more

intriguing articles involved an investigation of the role of male faculty in parenting (Sallee, 2013). This particular perspective disrupts the stereotype that housework and childcare are women's work.

An aspect of faculty recruitment not reflected in current data, regarding the leaky pipeline in the STEM professoriate, is the problem of bias in STEM doctoral-level education and training. The study conducted by Sheltzer and Smith (2014) revealed that male professors tended to train fewer women than men in science laboratories. They asserted that this may be a result of self-selection among female scientists or unconscious bias on the part of male professors. In either scenario, gender bias in the STEM fields negatively influences the number of women who choose to pursue STEM academia. To improve women's participation in the engineering workforce, it was important to address the representation of women in engineering academia, the individuals who provide the instruction and requisite training needed to produce qualified engineers for the workforce. According to Fouad (2014), the engineering profession has the highest turnover of women as compared to other skilled professions, such as law and medicine. With women representing over 20% of engineering school graduates (Yoder, 2017) and only 10.7% of engineers (National Society of Professional Engineers, 2015), this gender demographic in engineering academia indicates a shortage of women in mid-career and senior-level faculty positions. This shortage of women engineering faculty is further blighted by the fact that women are not applying as often for tenure-track positions despite the increase in women earning PhDs. The National Academies (2010) chronicled that women received 45% of the PhDs in biology (from 1999 to 2003) but accounted for only 26% of

tenure-track applicants. Comparable data was found in Bowman's (2013) research, which reported that while the number of PhDs granted to women increased by more than 75% (from 2002 to 2012), women represented less than a quarter of new assistant professors, with the lowest representation in electrical and computer engineering.

The Organization for Economic Cooperation and Development (OECD) (2015), a consortium of 34 countries that work to promote economic growth, prosperity, and sustainable development, reported that women represent about 60% of U.S. university graduates, outpacing men in higher education. Among post-baccalaureate degree recipients, women earned 60% of master's degrees and 52% of doctoral degrees (OECD, 2015); these trends are also reflected internationally. OECD (2012) reported that in 2010, in every OECD member country, with the exception of Japan and Turkey, women represented over 70% of education majors and over 74% health and welfare majors; however, less than 30% of engineering majors were women. OECD (2012) indicated that gender gaps in employment rates and salary are partially a result of women's under-representation in the fields of engineering, manufacturing, and construction. In spite of women's unprecedented rate of entry into university-level programs, women still linger behind men in the STEM fields overall and more so in engineering.

Researchers have documented various factors that influence women students' experience in STEM undergraduate degree programs; and they conducted pilot studies on interventions developed to improve academic performance and increase retention and graduate rates. One such study, conducted by Miyake et al. (2010), tested the effectiveness of *values affirmation*, a psychological intervention that emerged from

Steele's (1997) work on stereotype threat, in reducing the achievement gap in a college class. The basic values affirmation intervention involved asking students to reflect on their personal values and countering the fear of negative stereotypes regarding their identities. In a randomized double-blind study, Miyake et al. (2010) assigned 399 students to a values affirmation group or a control group) and gave students a 15-minute writing exercise in weeks one, four, and five within a 15-week physics class. While both groups completed the exercise, the exercise was only self-relevant for the values affirmation group. The study's findings showed that women students, in the control group who only moderately endorsed the stereotype, had lower exam scores, while women students, in the values affirmation group, earned a considerably higher grade for the class, from C to B. Academic performance was strongest in women students who rejected the stereotype that men were better at physics than women.

In a more dated study, Riney and Froeschle (2012) administered an open-ended questionnaire to 55 undergraduate engineering students (28 females and 27 males), prompting students to recount their experiences in their engineering program. The researchers returned the responses to students two weeks later to provide opportunity for students to expound on their original responses. Responses were coded by two researchers, and differences in the coding patterns were transferred to a third coder who resolved the discrepancies. The common theme that emerged from the responses was *academic stress*. A secondary theme was connected to students' sentiments about their *professors' concern for them*; overall, students (both females and males) opined that professors were reluctant to help them due to professors' focus on their own research. On

the experiences of working in groups, both male and female students reported having positive experiences. However, female students expressed vexation over what they believe to be unequal treatment and inconsistencies regarding group-work expectations for male and female students. This study pointed to the need for continuous examination of engineering educational environments to determine where improvements can be made—whether it involved group-work, classroom instruction, pedagogy, academic social interactions—in order to improve the retention of female engineering students.

Notwithstanding the gradual increase in the number of women pursuing doctorate degrees—along with studies confirming women's advantage over men at getting tenured and tenure-track positions (Williams & Ceci, 2015)—few women are pursuing the STEM professoriate, an indication of significant implicit gender bias in STEM academia. MacPhee and Canetto's (2015) study suggested that attainment of balanced representation of women and men in faculty positions continues to be challenging, given the fact that women doctorate recipients were less likely than men to pursue academia. In addition to identifying the factors related to the recruitment challenges for women in STEM academia, retention and persistence were also important measures when looking to increase number of women in STEM in general. Rankins, Rankins, and Innis (2014) asserted that the participation of women in STEM baccalaureate programs, the period of time when academic guidance and inspiration are strongest, is profoundly influenced by the presence of women STEM faculty at all professorial levels. In order to effectively reinforce the sense of belongingness and offer social and professional support to women

students, they emphasized the importance of access to same-gender role models who can serve as mentors.

To better understand the phenomenon of women in STEM, Rankins et al. (2014) used a Representation Index (RI)—defined as a group's representation in a specific category in relation to that group's representation in the U.S. population—with an RI of 1.0 indicating equal representation. They revealed that women's representation decreases as educational attainment and faculty rank increases. At the full-professor level, RI for women in STEM disciplines was less than 0.8 and less than 0.2 in computer science and engineering. With regard to women of color, RI for the full-professor level was 0.08, nearly undetectable. To demonstrate meager representation of STEM women faculty at the full-professor level, a cross-disciplinary comparison was made. Resultant data revealed that even in psychology, where women represented 77% of undergraduates and 55% of the faculty, women were still under-represented at the full-professor level.

In examining the current literature on women in STEM academia, two research studies revealed how gender stereotypes influence women's career choices job effectiveness, and career advancement in fields that are traditionally male-dominated (Van der Lee & Ellemers, 2015; Xu & Martin, 2011). Among the stereotypes that assign intellectual aptitude and fitness with men is one that attributes mathematical-logical ability and reasoning as being essentially male traits. Van der Lee and Ellemers (2015) concluded that science is more implicitly associated with men because gender stereotypes characterize women as lacking the stereotypical male traits associated with scientific aptitude. These gender stereotypes adversely impact the socio-cultural environment and

representation of women in the STEM fields. By contrast, the gender stereotype study conducted by Xu and Martin (2011) used a mixed-method approach to examine the role of informal professional networks in women's under-representation in STEM. They found that homophily—which is the tendency of people to socialize with others who are similar to them—and aggregation of women faculty to lower academic positions contribute to maintaining an in-group faculty that is uniformly male. Further, the male networks may themselves exclude women, thus amplifying the disconnect women already experience in a male-dominated profession.

Newer perspectives on gender stereotype reveal that it is the stereotype of the field itself that also lends to the gendered compositions in male-dominated fields. Leslie, Cimpian, Meyer, and Freeland (2015) hypothesized that women were least represented in fields that are believed to require innate talent; and in fields such as engineering, mathematical aptitude and talent are attributes not traditionally associated with women. This particular hypothesis, termed *field-specific ability beliefs*, is similar to stereotype threat, a situation wherein people face the risk of conforming to a stereotype about their own community; their internalization of stereotypes about their gender, race, or ethnicity diminishes performance and acts as a self-fulfilling prophecy (Steele, 1997).

Smith, Lewis, Hawthorne, and Hodges's (2013) research study substantiated the reality of field-specific ability beliefs. To test the concept of *fixed mindset* (Murphy & Dweck, 2010), Smith et al. (2013) surveyed 149 STEM graduate students (81 from the University of Oregon and 68 at Montana State University), of which 75 were female. Survey results revealed that female students believed that they needed to exert more

effort than their male peers in order to succeed and that additional effort equated to lack of innate ability. This study validated the enduring impact stereotypes have on personal motivation and how such beliefs undermine women's ability to persist in the STEM fields even when they have demonstrated performance success. Stereotypes and field-specific ability beliefs present women as the lesser sex, but they are not the only factors that threaten academia's ability to generate a viable STEM workforce.

To improve women's overall social mobility and economic strength in the STEM workforce, some studies examined specific strategies, such as mentoring (Abriola, 2014) and other short– and long–term interventions (Amelink & Meszaros, 2011) designed to improve the educational experience for women faculty in STEM academia. Abriola's (2014) survey of research–intensive institutions—involving 500 departments and 1,800 full-time tenured and tenure-track STEM faculty—revealed that while women accounted for 17% of tenure-track and tenured position applications, the percentage of applications for women was lower than the percentage of positions filled. When looking for differences at the promotion stage, Abriola (2014) found no significant gender disparity; and women were promoted to the level of full professor at about the same rate as men. However, the data also revealed that tenured women were most under-represented in the fields for which they represented the larger share of the faculty, namely biology and chemistry. This implies that women's early departure at the stage of assistant professor, before they reached the level of associate professor. These findings suggested that departments have not considered special retention strategies to help women faculty attain tenure, although they have been more effective in terms of faculty recruitment. Some

recommendations that were generated from this study included reduced course load for new faculty, one-term research leave for junior faculty, formal mentoring with junior faculty paired to senior faculty, and an opt-out one-year tenure clock stoppage for faculty who are primary caregivers.

Not unlike the importance of mentoring for junior women STEM faculty, mentoring of women in STEM at all stages has been shown to be an effective retention strategy. In examining both extrinsic and intrinsic factors that impact both female and male students' persistence in engineering degree completion, Amelink and Meszaros (2011) discovered that faculty interaction and feedback with students—in particular, the degree to which faculty regarded students with respect—was more significant for female students and considered an encouraging factor. However, the amount of study time and competition for grades were seen as discouraging factors by both male and female students. This study supported the assertion that women's persistence in STEM is highly influenced by environmental factors, such as negative stereotypes; and the availability of faculty mentors offers a practical strategy for shaping the educational experience for women STEM students. It suggested that motivational factors responsible for women's entry into STEM may be different than those that drive persistence in STEM.

Beyond increasing the number of women who enter the engineering workforce, in order to supply the demand of next generation engineers, women in STEM academia play a critical role in helping to moderate the gender-wage gap. Chang (2010) argued that because STEM occupations were ranked as high-wage occupations, the under-representation of women in STEM goes beyond income disparity and rather, it is a matter

of income equality. Based on the annual populations report published by the U.S. Census Bureau, in 2016, women earned $0.79 for every $1.00 earned by men; and for full-time employment, this amounts to an average annual wage of $39,621 for women as compared to $50,383 for men (DeNavas-Walt & Proctor, 2015). The pay gap between men and women is not a result of gender but rather it is a result of women's occupations in lower-paying fields. Encouraging more women to enter the field of engineering, considered a high-wage occupation, will significantly reduce the pay gap.

Notwithstanding the comparatively higher salaries commanded by a career in engineering, Lee and Won (2014) argued that because women account for only one-third of full professors, women in academia as a group, taking into account assistant, associate, and full professors, earned less than men in academia. Based on the premise that gender discrimination persists in the awarding of promotion and tenure, the researchers examined how women's representation by rank in the academic hierarchy predicted gender equity in the salary at the assistant professor rank. Results from four-year universities revealed that women's representation at the full professor rank was positively associated with increased salaries at the assistant professor rank; however, representation at the assistant and associate professor ranks was not associated with salary disparities. In other words, the presence of more women in the higher ranks of academia contributed to salary equity for junior women faculty. Though the study avoided any conclusive remarks about causal relationships between women's representation at the full professor rank and reduction of the salary gap at the assistant professor rank, the results suggested that the presence of more senior women faculty makes available additional support to

junior women faculty, such as through mentoring. Lee and Won's (2014) study also revealed that institutions with a female president tended to have a greater salary gap: "Scholars suggest that women who aspire to power positions are required to internalize the dominating norms of the organization, and they cannot join the organization as a woman" (p. 337). These female presidents conformed to a male-centered leadership persona and maintained socio-cultural expectations of role congruity as they repositioned themselves in top management positions.

Unlike the perspective held by Lee and Won (2014)—which indicated that more women at the higher ranks will increase equity for women at the junior ranks—the study conducted by Moss-Racusin et al. (2014) evaluated both the positive and negative outcomes of existing interventions utilized for women in science academia and concluded otherwise. Moss-Racusin et al. (2014) suggested that academic scientists express *implicit biases*, which aggravate and increase social-cultural stereotypes that emphasize the notion of white male scientific competence. Of the interventions that were examined, that which involved giving male and female professors identical applications for laboratory positions resulted in considerably higher evaluations delivered for male applicants. The researchers maintained that while there was no evidence that deliberate *explicit biases* were responsible for the lackluster evaluations given to female applicants, they recognized that implicit bias often functioned outside of conscious awareness. This weakens women professors' perceived sense of self-efficacy and distorts the merit-based system in academia. This implicit bias is considered a formidable influence that even the presence of a high-ranking female is insufficient for nullifying its effects on women.

Aligned to Lee and Won's (2014) view of the positive effect that higher-ranking women have on younger women, Pereira's (2011) study of women engineering geology students found that self-efficacy can be developed through the combined efforts of both tutoring and mentoring by a higher-ranking female faculty. Pereira used a sample of 44 women engineering geology students and 15 tenured women faculty; and among the women faculty, one professor had an engineering geology background. Focus group meetings and individual interviews revealed that students perceived tutoring of the final projects provided by faculty as impactful and contributed to increase in self-efficacy. Despite seemingly incompatible difference in disciplines, the presence and participation of higher-ranking women offered an adequate environment for role modeling.

When discussing the leaky pipeline to engineering academia, researchers attempted to ascertain the influence of gender on multiple aspects of hiring and tenure. Using over three decades of data collected by the National Science Foundation across all science and engineering disciplines, Shaw and Stanton (2012) developed a model that identified two non-structural bottlenecks that they believe restrict women's participation in academia. These two bottlenecks included choice of undergraduate major and application to faculty positions. They argued that although it is often the case that bias is inferred, wherein minority groups are under-represented in certain academic positions, this reasoning fails to account for the sustained effects of historical inequalities. Due to the amount of time that an individual spends in an academic position, onward of years to decades, modifications to hiring practices or interventions for promoting diversity may

not lead to immediate resolutions of inequalities. This situation lends to demographic inertia wherein a time delay is anticipated.

Shaw and Stanton (2012) contended that the hiring and retention of women in academia continues to be influenced by demographic inertia, but the influence of gender appears to be diminishing for most disciplines. Inequalities in hiring and retention of women can be represented in various ways. However, the wide-ranging personal experiences often distorted the interpretation of the current condition of women in academia. This model predicted that over time, increases in female undergraduate enrollment in the majority of science disciplines will increase overall female participation in all stages of academia; it is just a matter of time.

Contrasted against the research of Shaw and Stanton (2012), which suggested that the under-representation of women in STEM is bound to naturally decrease over time, Smith et al. (2013) study of women in STEM graduate programs revealed that women's under-representation in STEM is persistent and more a function of self-perception. This study measured four items on a 5-point Likert scale to assess perceptions of effort expenditure. These items were: (a) "Compared with other students, how much effort do you expend in your field of study?"; (b) "Compared with other students, to what extent to do you find the material and work in your field challenging?"; (c) "Compared with other students, to what extent does your field come easily and naturally to you?"; and (d) "Compared with other students, how much energy does it take you to succeed in your field?" Results revealed that women who felt as if they exerted more effort in STEM felt

a decreased sense of belonging, and eventually, they experienced decreased motivation overall for the discipline.

Consequentially, these feelings of non-belongingness impeded women's ability to success in the discipline (Smith et al., 2013). The study's results implied that women used effort expenditure to evaluate their fit in STEM. By and large, even among women who demonstrate academic competence in STEM, the feelings of belongingness supersede self-efficacy, and these feelings take a toll on women's motivation to persist in STEM. Hence, women's perception of their ability to succeed in a male-dominated STEM field undermines their interest in these fields. This study also pointed to the importance of retention of women in STEM graduate programs, since these are the individuals who are generally the prime candidates for academic positions.

A study conducted by Stepan-Norris and Kerrissey (2015) examined the effectiveness of an intervention supported by an NSF-funded program, ADVANCE, developed to increase the participation of women in science and engineering careers. Implemented at the University of California, Irvine (UCI), the researchers compared data on women faculty's representation before and during the ADVANCE intervention to that of seven other UC campuses where no initiatives were implemented. From the results of descriptive analysis, *t*-tests, and regression analyses, they found that UCI hired more women during the ADVANCE intervention. However, these women were not retained at higher rate than those from the over seven campuses. While this study demonstrated vigor in the hiring process, it also recognized that retention was as important as is recruitment.

While the salient aspect of retention of women faculty was not addressed by the study conducted by Stepan-Norris and Kerrissey (2015), Wolf-Wendel and Ward's (2014) study addressed the role of academic discipline on the careers of tenure-track women who had children. Their longitudinal findings—from interviews with 118 pre-tenured women (34 from humanities, 21 from social sciences, 30 from STEM, and 33 from education and business) with children under the age of five—presented several aspects of how the discipline and model worker norms influenced women's experiences in academia and in motherhood. In narrating the life cycle of the typical women in academia, they presented the fact that the average woman academic earns a doctorate at age 34; and that average women professor typically moves through tenure within a 6-year period, earning tenure at age 40. For those who waited to earn tenure before family formation, challenges were abound given that female fertility declines appreciably after age 35. Indeed, attempting to manage through the tenure process and at the same time attend to family formation continues to be a conundrum for women who pursued academic life. The study findings revealed that in the humanities, where work is more individually-oriented, women professors were able to produce work arrangements that fulfilled both their teaching and research load and family obligations.

By contrast, women professors in the STEM fields—which involve laboratory and team work—were more conscious of their absences (Wolf-Wendel & Ward, 2014). These women saw their absences for family obligations as an ostensible indicator of their deficiency as a STEM professor and felt compelled to maintain productivity. Moreover, STEM professors face more obligations, than those in other disciplines, to maintain

sufficient funding through grant writing in order to continue research laboratory work. In fact, this places further stress on women STEM faculty and manifests itself in terms of anxiety about deadlines. STEM faculty with children reported that they often felt the pressure of ideal worker norms as it relates to STEM being driven by laboratory work: "My colleagues that don't have children stay at the lab late and go to the pub after to discuss work. I see this is part of what it takes to be successful. I can't do this with having a family" (Wolf-Wendel & Ward, 2014, p. 25). The nature of STEM academic work created a different set of expectations for women in these fields. To better understand women's under-representation in engineering academia, a review of literature on the general nature of the academic tenure process, including the particular challenges presented for women, was explored.

Women and the Academic Tenure Process

Over 60,000 doctoral degrees are awarded annually, to both U.S. citizens and non-citizens, with half conferred by research institutions from the Association of American Universities and the other half from other doctoral-granting programs (Mason, 2012). Despite the pool of potential academics, Mason (2012) described a decline in the number of faculty who were tenured or tenure track, dropping from 55% from the 1970s and 1980s to 31% in 2007. At the same time, there was continual increase in the number of part-time and adjunct faculty positions. One reason for the steep decline was attributed to sentiments regarding family formation. The findings from a study conducted by Mason et al. (2013) reported that over 70% of University of California female doctoral students and about 50% of male doctoral students expressed reluctance toward pursuing academia

due to a general sentiment that it was unfavorable to family life. In part, this resulted in fewer than half of all PhD recipients holding faculty tenured positions.

Contrasted against careers in industry, where an increase in salary and promotion are indicators of success, the attainment of tenure is unique to higher education and considered the mark of career success in the academic world (Mason, 2012). Those who pursue academia recognized the path to attaining tenure—an employment relationship in which institutions of higher education recognize a faculty member's academic freedom, along with provisions for increased job security—to be a long one, involving teaching, scholarship, and service (Mason, 2012). Women represent the smaller share among faculty who achieve tenure (Gardner & Blackstone, 2013; Gardner & Veliz, 2014; Mason et al., 2013; Rhoads & Rhoads, 2012; Wolfinger, Goulden, & Mason, 2010; Wolfinger, Mason, & Goulden, 2008). An explanation for the meager representation of tenured women was found in studies that demonstrated the challenges that women academics faced with regard to conducting scholarly research (Lincoln et al., 2012; Vaid & Geraci, 2016); but much of this may also be attributed to issues of work-life balance which will be discussed in the subsequent section.

On examining data of women in engineering academia, the data of women in the STEM fields in general, must also be considered. Women comprise about 18% of tenured and tenure-track positions in STEM academia (National Academies, 2010); and women's representation in engineering academia is lower, at about 15.7% (Yoder, 2017). At the full professor rank, the representation of women in STEM academia is 21% in science, but it is only a mere 5% in engineering (National Academies, 2010). How 5% of women

in engineering academia achieve full professorship is a question that few studies have attempted to address. In the absence of studies that explored the experiences of women in engineering academia, specifically with regard to the navigating the tenure process, this section of the literature review focused on contextualizing the under-representation of women in engineering academia via a review of literature about women and the tenure process, in general. Selected literature included current data on women in academia, studies that examined impediments to the tenure process (such as availability of faculty support and resources for women), gender bias in retention and promotion, and a generalized view of higher education institutional culture and the climate of academia for women.

Given the data published by the National Center for Education Statistics (2015) suggesting an academic environment that strongly favors the hiring of women—along with William and Ceci's (2015) study demonstrating faculty preference for women in STEM tenured-track positions—opportunity exists for exploring causal agents for the gender differences in engineering academia. Williams and Ceci (2015) conducted national validation studies involving 873 faculty (439 male and 434 female) who held tenure-track positions in biology, engineering, economics, and psychology at 371 universities. The central study was an appraisal of narrative summaries from assistant professors with similar life-style backgrounds. The results revealed a 2:1 preference for women faculty hires in biology, engineering, and psychology, while no gender preference was present in the field of economics.

The National Center for Education Statistics (2015) reported the percent-distribution of faculty by academic rank, gender, and race/ethnicity. Looking at the tenure and tenured-track spectrum, in 2013—and not including professors of American Indian/Alaska Native and two or more races—the percent-distribution by gender: 69% men and 30% women for full professors, 56% men and 43% women for associate professors, and 48% men and 50% women for assistant professors. However, when looking at non-tenured position, such as lecturers and adjunct instructors; and the combined percent-distribution of non-tenured individuals was 44% and 54% for men and women, respectively.

Along with the drop in the percent-distribution of women from assistant professor to associate professor, these figures indicated that women are concentrated at the lowest levels in academia. This trend suggests that gender composition is skewed at the associate professor and full professor ranks even though women have the same opportunities that male are afforded at the hiring level, with women out-numbering men, at 50% versus 43%. While it is important to note that this data did not account for other factors, such as the extent of hiring at the higher ranks as well as retirements, opportunities exist at the assistant professor rank, where women are over-represented, to improve gender equity for women just as they enter the tenure track professorial pathway.

In trying to grasp an understanding of women's experiences with the tenure process, researchers also explored the under-representation of women in leadership positions (Dominici, Fried, & Zeger, 2009). Given that academic deans and chairs are in the best possible position for diversifying academia—including implementing new

approaches for equity in tenure and promotion—attributing the shortage of women in the STEM professoriate to a dearth in women in academic leadership is not beyond the realm of possibility. Dominici et al. (2009) emphasized the significant role that women leaders play in mitigating gender inequity in STEM academia.

Stymied by a desire to promote gender equity at John Hopkins University, the University Committee on the Status of Women introduced a formal process for interviewing senior women faculty to help identify and eliminate obstacles women faculty faced. The committee conducted five focus groups, involving a sample of 27 women (from the areas of public health, engineering, medicine, nursing, music, arts and sciences, and business); and among these, eight were represented in the ranks of department chair, dean, or provost, while the remaining 19 were professors (i.e., full, associate, or assistant). The researchers discovered that even with institutional support, the percentage of women in academic leadership positions was low, as compared to both the percentage and total numbers in the pool of eligible tenured women faculty. The researchers emphasized that women's leadership is often consistent with a communication style that is communal and participative, which tends to be incompatible with the more transactional and hierarchical leadership style more aligned to a man. While the researchers contended that women administrators were generally excluded from male networks—because they may not conform to the leadership in a male-dominated academia—it was not clear whether they deemed women's communal and collaborative work style an effect of gendered socialization and whether this style was amplified by women in academia because they believed it was important in establishing

the required networks needed for success. However, they conjectured that the ability to build networks was one strategy women took in response to male exclusion from academic circles. They also considered whether women weighed in the investment of time needed to building networks against available support and resources and whether men would achieve the comparable networks given the same level of support and resources and all other circumstances being equal.

Emphasizing women's focus on fulfilling the expectations of their peers and men's quid pro quo approach to self-interest, the mainstay of the study by Dominici et al. (2009) was consistent with Gilligan's (1982) feminine ethic of car, which argued for women's intrinsic nurturing role, relating more with people. At the core of this thinking, feminist morality materializes as a relevant frame. Gilligan (1982) contended that one of the shortcomings of feminist thought is its overstatement of economic and political relationships and limited view of interpersonal relationships, such as family life. Accordingly, Gilligan's (1982) feminine ethic of care represents a determining notion exploring alternative connections between gender and other experiences.

In considering women's role in academia, deemed to be male-dominated, against the setting feminist philosophy, the motive of care emerges as a significant feature. Current studies show that work-life balance is a hurdle for women in academia (Aiston & Jung, 2015; Bell, Rajendran & Theiler, 2012; Kalil, Dunifon, Crosby, & Su, 2014; Skinner & Dorrian, 2015). However well-intentioned in inspiring gender equity, one of the major criticisms of Gilligan's (1982) feminist philosophy is its embrace of femininity—a wholly separate experience felt only by women—is that it reinforces the

stereotype of women as being care-focused. At the same time that Gilligan encouraged women to express the feminine voice, she also conceded that women must overcome the social construct of womanhood in order to succeed in the world of men. Her philosophy of care and justice was limited with respect to the discussion of the interpersonal relationships that occur in the private domain of family life. Absent was the dialog on the mother-child relationship, even though the fundamental position Gilligan (1982) took is one in which women are nurturing beings.

Social conditioning produced deep-seated beliefs about how men and women should behave. Our social constructed views and ideologies of the quintessential leader stereotypically subscribes to the dominant male justice orientation described by Gilligan (1982). Ibarra, Ely, and Kolb (2013) maintained that women's under-representation in leadership positions is a result of a number of deterrents, such as their exclusion from networks and lack of mentorship. Aligned to Gilligan's (1982) feminine ethic of care, Ibarra, Wittman, Petriglieri, and Day (2014) stated that social views tend to ascribe women as being "communal—friendly, unselfish, care-taking—and thus lacking in the qualities required for success in leadership roles" (p. 292). However, they recognized that in today's organizations, work places are beginning to favor teamwork and trust, requiring leaders who are able to listen and support; and these attributes are more aligned to Gilligan's (1982) female care orientation. Hence, leadership development programs that underscore women's inherent communication style might potentially increase women's representation in male-dominated career fields.

While factors for women's under-representation in the STEM work force have been widely documented, studies conducted of women in the engineering—which have generally incorporated terms such as *chilly* to describe male-dominated work places (Malu et al., 2004; Yonemura, & Wilson, 2016)—more often explore the condition of women and scarcely on women engineering faculty. Among extant literature exploring the experiences of women in academia, Hart's (2016) research focused on mid-career women who were at the most prepared stage to undertake a leadership role in academia. However, Hart (2016) also stated that the timing of tenure decisions regularly coincides with the peak childbearing years, requiring mid-career women to confront the conflict between the biological time clock and the career time clock. Consequently, the tendency for women in senior leadership roles to be single and without children is high; yet for men, marriage and parenthood accompanied higher wages and leadership roles (Eagly & Carli, 2009). When children are involved, women in academia bear the burden of childcare and domestic responsibilities; and the likelihood of gaining tenure is diminished (Rhoads & Rhoads, 2012). Women who have children while pursuing tenure experience gender inequity on a greater scale and achieve promotion at a slower rate than those without children (Gardner & Blackstone, 2013; Gardner & Veliz, 2014).

Aiston and Jung (2015) examined the gender gap in terms of research productivity and its relation to family variables. In their gendered analysis of the Changing Academic Profession Survey (CAPS), an international 16-page survey of academics from 19 countries, they chose to examine CAPS data of five countries: Finland, Hong Kong, Germany, Japan, and the United States. Their analysis showed that academic women

were less likely to be married as compared to their male counterparts; however, married academic women were more productive than unmarried academic women. Challenging the common view that family hinders the performance requirements of academia, the results indicated that being in a partnership may provide a positive level of informal support. Their analysis also showed differences in research productivity among women with respect to taking breaks to care for children. Naturally, it is expected that career breaks would negatively affect research productivity. However, the analysis showed that women academics—with the exception of those from Hong Kong who took breaks—were more productive than those who had not. In examining results by discipline, women in the humanities and social sciences from Hong Kong and Japan, who took career breaks, were less productive; and those who did not take career breaks published 2.3 times more articles.

By contrast, women in science and engineering from the United States who had taken breaks were less productive. The cross-comparison by country showed that women academics in both Hong Kong and Japan were marginally more productive, while women in Germany and Finland were significantly more productive. Inconsistent with the common notion of work-life balance and the constraining effects of family on research productivity, these findings suggested that women with children may indeed strive to do more with their limited time. Apparently, this was the case for women who were doing work during their career breaks.

Aiston and Jung's (2015) analysis revealed that while family-related variables accounted for the difference in research output, the narrative that associates women

academics' research productivity with family-related variables was a problematic one. They asserted that because mainstream literature over-emphasizes family as the framework for accounting for the gender gap in academia, it deters researchers from exploring new hypotheses. Their analysis was a rejection of the widely held assumption that family responsibilities compromise women's academic career choices and influence the recruitment and retention of women in academia. Unlike many studies on work-life balance involving women in academic, they demonstrated that the presence of family was not generally perceived as a form of negative equity in academia.

Speculating that the same deterrents affect women in engineering academia as they would in industry, a number of studies point to the relationship between mentorship and success in academia (Bird, 2011; Carlson, 2015; Chang, Welton, Martinez, & Cortex, 2013; Ceci, Ginther, Kahn, & Williams, 2014; Fox, 2011; Fouad, 2014; Gray, 2012; Hancock, Baum, & Breuning, 2013; Lee & Won, 2014; Leonard & Nicholls, 2013; Ponjuan, Conley, & Trower, 2011; Steele, Fisman, & Davidson, 2013).

Institutions of higher education, and in particular, the research-intensive institutions, often obligate women academics—considered to be gendered minorities in many of the STEM fields—to participate in activities that advance gender diversity at a disproportionately higher rate than expected of men (Turrentine, 2015). While service is one criterion in tenure evaluation, it is often ranked as less significant to research in the tenure award system; yet women academics are typically encumbered by larger service burdens (such as student advising and serving on campus committees) than their male counterparts. This discourse was supported by Bird's (2011) case study involving a mid-

sized research-intensive university in the U.S. Midwest. Bird (2011) theorized that universities are fundamentally incongruous, gendered bureaucratic structures where women academics are consigned to activities that are less valued in the tenure process. Bird (2011) suggested that junior women in tenure-track positions be offered fewer services burdens in the beginning years to allow them time to become established. While this recommendation is ideal, it is the case that junior faculty are encumbered with these sorts of activities that tenured faculty would more often avoid.

Bakker and Jacobs (2016) examined the effect of the tenure track system at Wageningen University (located in the Netherlands) on both male and female promotion rates. They found that promotion rates were equal between men and women before the tenure track system was introduced; but remarkably, the promotion rates were improved for women more than for men after the tenure track system was introduced. It is presumed that these results can be best explained by affirmative actions that were implemented in favor of women. Despite these results, the study also demonstrated that higher promotion rates for women did not lead to any significant improvement to tenure levels (i.e., associate professor, professor). The degree to which women were able to advance through the tenure process was explained more in terms of retention; and that particular area has yet to be explored in this study. By contrast, the study on tenured women by Box-Steffensmeier et al. (2015), which observed 2,218 tenure-track assistant professors in seven social science disciplines at 19 American universities, found no statistically significant differences between men and women in terms of faculty retention. However, the findings did show that men were more often granted tenure than were

women. Among several explanations for gendered difference in the tenure rates between men and women were: women scientists were lacking sufficient resources conducive to higher rates of publication than men; differences in years of service and external mobility; women tended to devote a proportional greater amount of time toward teaching as opposed to research; and lastly, women expended more time on childcare obligations as compared to their male counterparts.

Women and Work-Life Balance

The National Alliance for Caregiving (2015) reported that women comprise 66% of caregivers in the United States, and that the average care-giver is a married, employed 49-year old woman who is also caring for an elderly parent. Hence, aside from the shortage of women in engineering—both in industry and academia—is the recognition that women professionals may also have obligations as primary caregivers to their children (National Alliance for Caregiving, 2015). As compared to men, women provide the majority of informal care to multiple members of the family—such as children, spouses, parents, parents-in-laws—and their caregiving duties often provide the mainstay of support for the family (Navaie-Waliser, et al., 2002). Accordingly, the discussion of women in engineering must also incorporate the topic of work-life balance and the ways in which academia can increase the participation of women through the use of family-friendly employment practices. On the discourse of work-life balance and how it impinges upon career choice, new perspectives are needed to make sense of why so few women are entering engineering academia.

Research studies involving women STEM professionals—specifically those with children—are limited and largely indicate that the work environment of the STEM fields is not conducive to mitigating the work-life balance issues for women (Yonemura & Wilson, 2016). Apparently, non-existent are studies that explore the experiences of women in engineering academia who are also primary caregivers of children. The absence of empirical research studies, involving women who attained tenure while at the same time held primary responsibilities for childcare, is a result of the severe under-representation of women in engineering academia altogether; and researchers must draw from the extant literature involving women in non-engineering STEM fields. On the whole, the current body of literature primarily focused on identifying the various impediments experienced by women in engineering but falls short of offering any insights into the perceptions held by tenured or tenure-track women engineering faculty who also attended to the needs of children. The gap in literature offered an opportunity for introducing meaningful discussions about how women engineering faculty navigate work-life balance issues while persisting through the stages of academic tenure. Inevitably, it is hoped this will advance researchers' understanding of the phenomenon and help them discover the critical moments that shape the career trajectory of women in engineering academia.

Beyond examining studies that investigated the role of gender bias against women in STEM academia and those that described women's experiences with the academic tenure process, studies that focused on women and work-life balance offered an alternative perspective that considers the competing roles of women in the workplace and

in the family. Work and family life represent two significant domains for women; hence, gaining insight into how women reconcile work and family life will support the interpretations of this study's results.

The current literature on work-life balance offers a shifting repertoire of research, ranging from work-related stress to the physiological effects of sleep deprivation to non-traditional work-family arrangements (Bell et al., 2012; Kalil et al., 2014; Skinner & Dorrian, 2015). Of the various studies on work-life balance, women's experience in the non-engineering STEM professions, primarily medical and nursing, represented the majority of studies (Beckett, Nettiksimmons, & Howell, 2015; Bhattacharjee, 2004; Lindfelt, Ip, & Barnett, 2015; Williams & Ceci, 2012). Among studies that focused on comparing how men and women attended to work-related issues, gendered use of time—particularly parental time that permeates multiple domains of family life—emerged as a prominent topic. Pappas (2011) argued that even women who were able to effectively balance the public and private spheres of their lives, and considered *supermoms*, were at risk of higher rates of depression. The gendered use of time appeared to mimic the traditional male-female power relationships because it reinforced the gender-segregated division of labor in the home. Hence, the notion of the supermom, "an ideal that women can do it all" (Pappas, 2011, para 3), is facilitated at the expense of women's health. However, the notion of the supermom is not without favor. Distinct gender differences in the use of time—with women assuming the greater share of domestic responsibilities and childcare tasks—were observed in a study of 10 men and 10 women faculty, each of whom had two to four children (Rafnsdóttir & Heijstra, 2013). The researchers examined

the concept of time with respect to gender and postulated that there is a power component to time, uniquely different for men and women:

> Power is related to time since time is an essential resource to which access may be unequally distributed. Those who have more power in their relationships are more likely to be able to manage their own time and the time of others in both the private and public realm. (p. 284)

Rafnsdóttir and Heijstra (2013) noted that the men in the study more often expressed having power over their own time and viewed family work as a project but without having to bear the responsibility for family work. One of the men surveyed stated, "Of course when they [the children] are sick and so on, you sometimes are in a position to take leave from work," (p. 292) implying that taking leave was not obligatory but rather a choice. By contrast, the women who were surveyed expressed being overwhelmed with daily routines associated with family and work life. When asked about family responsibilities, one of the women commented, "It's not a good deal for most women, I think" (p. 293), which implied that success in academia is not suitable for some women. Another woman described continuing her work even after the formal end of the workday: "Never…when I fall asleep…I don't quit at five because I work at home…if there is something I want to do, or need to do, I work at night" (p. 293). This suggests that women are overcompensating to legitimize their standing in academia, and in doing so, they may be generating their own feelings of being overwhelmed. The researchers contended that women's use of time materialized as traditional gender-segregated work (referring to reproduction and family care); and so, for women, time is cyclical. By

contrast, for men, whose traditional work is far removed from the vicissitudes of family life, time is linear, with distinct start and end points. Overall, the study was based on the assumption that traditional notions of men and women's social roles persisted, and that people do not live by clock time; but rather, their lives are oriented and directed by time that is task-oriented and socially constructed.

The study by Rafnsdóttir and Heijstra (2013) presented a distinct feminist view, one that epitomized the socio-cultural stereotype of women as being the nurturer. While the study presented multiple dimensions of women's work, including formal paid work and unpaid labor as it regards household work, it also validated the feminist view of expectations of reciprocity. Women academics were attempting to conform to a male-dominated work culture, but at the same time, women's feminine qualities and values conflicted with their ability to negotiate family responsibilities with the expectations of academia, a work culture that fundamentally corresponds to the constructions of masculinity. In light of this, Gilligan's (1982) feminine ethic of care offers a worthy sounding board for this study. In particular, her concept of "female altruism" (p. 70) implied that women were inherently predisposed to a different way of thinking than men and that traits intrinsic to women and men had command over the routine tasks of life. From this perspective, women find it more difficult to break free of the traditional gender-segregated division of labor. Consequently, women's interpretation of time tends to be influenced by emotions and affections, which are expressly manifest in Gilligan's feminine ethic of care.

The perspective of women's inclination toward traditional gender-segregated work is further supported by Rhoads and Rhoads (2012) who explored the association between gender role attitudes regarding childcare, the use of parental leave, and parenting preferences. The study utilized a multi-stage stratified sampling design; and drawing from a sampling frame of 168 schools, it identified 40 schools that offered paid leave, of which 28 offered paid leave for both mothers and fathers. In total, 319 university tenure-track assistant professors were surveyed. Eight measures—performance of childcare, breastfeeding, enjoyment of childcare, gender role attitude about sharing childcare, child's preferences, leave-taking, use of paid childcare, and spousal employment—were examined. While results revealed higher parenting participation rates in male professors, who believed in non-traditional gender roles and took paid parental leave, male professors contributed less to childcare as compared to their spouses and to female professors. This was the case even for male professors whose wives worked full-time.

The results of Rhoads and Rhoads's (2012) study showed that that there was no statistical significance between the measure of 'enjoyment of childcare' and 'leave-taking' status for men. The study indicated that female professors more often enjoyed childcare than did their male counterparts, thus their higher contribution toward childcare. The researchers suggested that because men and women differed in their enjoyment of childcare, changes in work-life balance policies may have little effect on eliminating the work gender gap.

In the same way that Gilligan's (1982) feminine ethic of care reinforces Rafnsdóttir and Heijstra's (2013) view that women are culturally constrained by

traditional gender-segregated family work, the results of Rhoads and Rhoads's (2012) study also laid bare the seemingly immutable nature of identity. Imagining identity as a synthesis of disparate parts, constructed by social structures, gender orientations, and other cultural patterns, rationalizes female professors' desire to contribute more to childcare even when options exist for obtaining additional support. In tackling numerous commitments simultaneously, the female professors expressed multiple identities; for example, the identity of a *mother*, a *professor*, or a *researcher.* For female professors, it was not a question of releasing themselves from family obligations in order to alleviate a burden, but rather, there was disinclination for relinquishing a part of what they expressed as their identity. In essence, they remained steadfast to the tradition of being mother first. The question of how these multiple identities interact in the social domain will improve our understanding of work-life balance and how best to support women engineering professors.

To understand the experiences of women professors, the identity of mother cannot be considered separate from the identity of professor; and in fact, one identity impinges upon the other and forms a third identity, that being mother-professor. Erikson's (1968) notion of *ego identity* sought to explain the phenomenon of multiple identities. His psychology suggested that multiple identities might be inherently unhealthy and undesirable. He described childhood identifications, which were multiple self-representations (not identities) that served as the foundation for a single adult identity. Erikson (1968) described the transformation of the adult identity:

> Identity formation, finally, begins where the usefulness of identification ends. It arises from the selective repudiation and mutual assimilation of childhood identifications and their absorption in a new configuration, which, in turn, is dependent on the process by which a society (often through subsocieties) identifies the young individual, recognizing him as somebody who had to become the way he is and who, being the way he is, is taken for granted. (p.159)

In other words, all of the substantial identifications from childhood to adolescence are incorporated into what he refers to as a "unique and reasonably coherent whole" (p. 161). Hence, Erikson's (1968) notion of ego identity offers little consolation for the idea of multiple identities. On the other hand, the psychosocial theory of development (Erikson, Paul, Heider & Gardner, 1959)—which describes the unfolding of pre-determined stages to identity development—supported the idea that adults have the capacity to re-discover themselves and change their outlook.

Among the studies that investigated the impact of role strain, Mason et al.'s (2013) survey of faculty from the nine-campus University of California system, revealed that marriage and children were the main barriers to women pursuing science academia. The research findings revealed that over 70% of women and more than 50% of men reported that faculty careers in research universities to be unfavorable to family life. Among those surveyed, only 12% of women and 14% of men were parents. Given the considerable percentage of faculty members reporting discontent over academia's lack of family-friendly policies, it was not unexpected that to find that 30% of women and 20% of men reported wanting to pursue non-academic careers. 54% of women reported

believing that academia was incompatible with child care, with 51% concerned about the availability of pregnancy leave. The survey results also showed that women faculty with children spent over 100 hours a week on caregiving responsibilities, as compared to men faculty, who spent on average 85 hours a week with children.

Illustrating sentiments about family formation, a female student expressed the futility of having a family while pursuing a doctorate degree, "We were already very ready to have a family, but I didn't see how we could make it work" (Mason et al., 2013, p. 11). These factors were not considered barriers by men. By contrast, only 36% of men reported concern about child care and 32% about pregnancy leave. When reviewing the results of one-on-one interviews with students pursuing bench science fields, which require large a commitment of time spent in the laboratory, the findings were distinct for men and women. Reflecting on the loss of time due to maternity leave, a female post-doctorate stated:

> I don't think I'll ever be able to do a tenure-track job, and people were very upfront with me about that when I had my child. Looking around me, I see that people are completely shut out of positions because of family. (Mason et al., 2013, p. 13)

Moreover, the study also revealed that married men with children are considered more capable of navigating work-life balance than women, reinforcing both the male status quo in STEM careers and the gender stereotype that females are unfit for STEM careers.

Mason et al.'s (2013) study explored the effects of family over the life-span of career academics. Using survey results from the *Survey of Doctorate Recipients* (1979–

1999), a massive longitudinal life course employment database which followed over 160,000 PhD recipients' post-degree employment experiences until the age of 76, Mason et al.'s analysis revealed that tenured women's life trajectories differed significantly from those of men. Some significant findings were: (a) unmarried women without children obtained tenure-track positions more readily than married women, mothers, or single unmarried men; (b) in the sciences, being a married woman with young children had a strong negative effect on the rate of tenure; (c) women who completed graduate studies were less likely to marry or become parents and more likely to be divorced; (d) women employed in tenure-track faculty positions were less likely to be married, experienced higher divorce rates, and had fewer children; (e) among tenured faculty, 12 years following the completion of the PhD, 70% of men were married with children as compared to 44% of women. Most striking of the findings was the fact that women PhDs employed in non-academic careers were more likely to have children than those in tenure-track faculty positions; and this disparity is commonly referred to as the *professor penalty*.

To explore more in-depth this difference between tenured men and women, Mason et al. (2013) also interviewed the entire nine-campus University of California (UC). Receiving responses from over 50% of 8,700 faculty members who were surveyed, they found a trend across all UC campuses—women faculty were twice as likely to report that they had fewer children than they wanted, as compared to their male counterparts. They also found that the average age when faculty members received their PhD was 33 and that a majority of professors did not achieve tenure before the age of 40. The years

between receiving the PhD and achieving tenure include an accelerated time for academic work but also coincide with the latter end of women's reproductive clock. The study also found that women assistant professors have newborns at a lower rate than men assistant professors; and that during the sixth and seventh year shortly after receiving tenure, women faculty's child-bearing rate approaches that of the men faculty's rate. However, after this period, men faculty continue having children—even experiencing increased number of children during the middle-age years—but women faculty do not. Mason et al. referred to the rise and fall in child-bearing patterns as the *baby lag* and *baby gap*. These finding implies that women faculty make comprises regarding career and children; and based on their responses, there may be some level of regret.

A comparable study, conducted by the same researchers (Wolfinger et al., 2010), examined data from the 2000 Census Public Use Microdata Sample to determine the probability of birth events among male and female professionals. The study revealed that although male science professors have fewer children than males in other professionals, women professors, regardless of academic discipline, were more often confronted with work-life balance conflict than were men. By-and-large, women's career trajectory was influenced by personal decisions regarding family formation and the biological time clock. The American Association of University Professors (n.d.) indicated the median age when women receive PhD's to be 34.1 years (compared to men at 32.8 years) and tenure at age 40. Consequently, the time to work toward tenure coincides with the prime child-bearing years; and tenure-track women must then choose between having a career and having children, a decision that men are not constrained to make. Having a general

understanding of the relationship dynamics of women in the workplace and family will aid in the interpretation of this study's research outcomes.

Also recognizing that conflict between the two domains is posited as being bi-directional, meaning that work can interfere with family life, and likewise family life can interfere with work, Nasurdin and O'Driscoll (2012) found it useful to discern whether women's under-representation in engineering academia is an outcome of person-organization fit or a consequence of institutionalized gender inequity. Amplifying the complexities of work-life balance are the tremendous workforce changes of the 21st century, including the higher employment rate of women and the challenges posed by dual-earner families (Ekert-Jaffé, 2011).

The current body of research suggested that engineering ranks highest among the STEM fields necessitating non-standard hours; consequently, women with children represent the lowest share in the engineering workforce (Mason et al., 2013). Coupled with a work domain that is incompatible with that of family, the stereotype of engineering as a man's job continues to steer women away from engineering. From the standpoint of human resources, the dearth of women in engineering is a person-organization fit issue. In the absence of scholarly literature on the experiences of women engineering faculty with children, an opportunity exists for introducing new research. The gap in literature can stimulate new perspectives and new approaches for addressing the status quo of women's under-representation in engineering academia.

The work-life balance conundrum was illustrated in a recent study, conducted by Yonemura and Wilson (2016), which explored why women leave the engineering

workplace. The researchers interviewed 45 individuals, 64% of whom were women. Expanding on previous work, they presented two research questions: one was related to the kinds of negative conditions women report in the engineering workplace and the other, whether men report similar negative conditions in the engineering workplace. Using existing classifications of chilly workplace conditions, qualitative analysis revealed that *hostile culture* was more likely expressed by women while *extreme work pressure*, *mysterious career pathways*, and *isolation* were expressed by both men and women. While the primary goal of the study was to discover additional conditions that steer women away from engineering, Yonemura and Wilson (2016) also wanted to understand the experiences of men: "Knowing more about the experiences of men will provide insight as to which engineering workplace issues tend to be gender-based and which tend to be more pervasive among engineering workers as a whole" (p. 4).

In reflecting on the various work-life circumstances faced by working women, it is conceivable that cultural differences may also play a role in mitigating work-life conflict. Because much of work-life balance research utilizes samples from Western nationals, it is important to examine studies that test the premise that work-life conflict is not simply a Western phenomenon. Nasurdin and O'Driscoll (2012) deployed an online questionnaire to professors, associate professors, and lecturers from two public universities, one in New Zealand and one in Malaysia. The results revealed that work overload was related to work-to-family interference, while parental demand was unrelated to work-to-family interference. In addition, family support (both instrumental and emotional) had little effect on the influence of parental demands. Patterns regarding

the relationship between workload and parental demands, including work-family conflict, were found to be common across the two cultures.

A competing study (Qiu & Fan, 2015) involving over 250 Chinese full-time employees produced conflicting results, altogether contradicting the idea that family support (or in the case of this study, family flexibility) mediated parental demand. Qiu and Fan explained that family flexibility moderated the effect of work interference with family, and in turn improved employees' life satisfaction. Western ideology dominates and imbues our notions of work and gender but ignores the non-Western discourse on work-life balance. A transnational study conducted by D'Enbeau, Villamil, and Helens-Hart (2015), involving women from the Middle East, North Africa, and India, exposed differences in cultural perceptions of equality, modernity (versus tradition), and individual (versus collective). Women from these non-Western cultures negotiated a complementary rendering of gendered performance in terms of professional and familial success as well as cultural pride. These studies offered no evidence that family support or family flexibility attenuated the effect of work-family conflict or work interference with family; but rather, the existence of family was a valued factor in contributing to professional success. Further, they demonstrated how gendered performance can be expressed in diverse ways connected to culture and religion, an interpretation not aligned to Western paradigms.

The study conducted by Poronsky et al. (2012) was most closely aligned with my study. With a focus on children and academic women's tenure experience, it offers parallels to the design of this proposed study. Another study on tenure track women

faculty, conducted by Minerick et al. (2009), offered an optimistic view of the effects of family-friendly policies and institutional support for mitigating work-life balance issues. Recognizing that work-life balance is not an issue specific to women, one of the more intriguing articles involved an investigation of the role of male faculty in parenting (Sallee, 2013). This particular perspective disrupts the stereotype that housework and childcare are women's work.

The changing and diverse landscape of the workforce, where women now participate at a higher rate than men—and in some cases, women serving as the head of household—offers a compelling reason for rejecting the status quo of women's traditional role (Vandello et al., 2013). Despite this, work-life balance continues to be a struggle for women; and little has changed in relation to of traditional gendered arrangements of domestic work, childcare, and family obligations. As women continue to serve as the primary caregivers of their children—regardless of whether they are partially- or fully-employed, in professional positions or vocational jobs, involved as a dual-earner in their family (Matias & Fontaine, 2015)—work-life balance continues to be relevant in the discussion of women in general.

Summary and Conclusions

There is a global demand for more engineers, one that outstrips the supply of eligible professionals (President's Council of Advisors on Science and Technology, 2012). Based on labor market data and job postings analytics, individuals with engineering degrees are in high demand in the job market. Of the top engineering professions, civil engineers account for the majority of engineering jobs, followed by

mechanical engineers and industrial engineers. Civil, mechanical, and industrial engineers, along with electrical and electronics engineers, make up two-thirds of the engineering workforce (Wright, 2014). With women representing half of our national workforce—and representing 10% of our engineering workforce—engineering may not be sustainable with such large-scale talent necessity (National Center for Education Statistics, 2015). Women also control the larger share of consumer spending (Silverstein & Sayre, 2009); hence, women's insights into product development are necessary to adequately serve the female clientele. Women's participation in engineering is vital to addressing both innovation and economic growth, as well as achieving gender equality and diversity in the workplace.

From a thorough review of literature exploring the status of women in three topical areas (women in STEM academia, women and the academic tenure process, and women and work-place balance), studies that involved women in STEM academia tended to use larger sample size, such as institutional level data. This indicates that researchers are paying greater attention to the critical constructs of representativeness; in other words, they want their study results to be generalizable. Several researchers have conducted studies that can claim generalizability: Eagan et al. (2014) surveyed 133 institutions; Maliniak et al. (2013) coded approximately 3,000 articles; Ceci and Williams (2015) surveyed over 870 faculty members in 371 colleges; Van der Lee and Ellemers (2015) examined 2,823 review applications from faculty; MacPhee and Canetto (2015) used a sample of 813 tenure-track and tenured research scientist; and Smith et al. (2013) surveyed 149 STEM graduate students.

By contrast, studies that explored the topic of women and the academic tenure process more often used an open-ended survey instrument or the interviewing method or a combination of both. Among those that used qualitative research, only two involved tenured and tenure-track STEM faculty. Williams and Ceci (2015) examined the narratives of 873 faculty, while Dominici et al. (2009) conducted multiple focus groups involving 27 women faculty. The majority of studies on tenure-track faculty involved non-STEM faculty: Aiston and Jung (2015); Bakker and Jacobs (2016); Box-Steffensmeier et al. (2015); Bell et al. (2012); Bird (2011); Dominici et al. (2009); Hart (2016); Ibarra et al. (2014); Kalil et al. (2014); Lincoln et al. (2012); Skinner and Dorrian (2015); and Vaid and Geraci (2016). Only two studies involved tenured or tenure-track women who held primary responsibilities for childcare; neither used women engineering faculty: Poronsky et al. (2012) and Rafnsdóttir and Heijstra (2013).

Chapter 3: Research Method

This study was focused on shedding light on women's underrepresentation in engineering academia. Because of my intention to inquire about the meaning ascribed to a social problem, I determined that the basic qualitative research approach was most appropriate for the study. In this chapter, I describe the research tradition and how it guided the development of the research questions. In defining the role of the researcher, I identify potential conflicts of interest and biases, such as personal or professional relationships with participants and power differentials, and I explain how these relationships were managed. I present the study's methodology, including participant selection, instrumentation, recruitment, participation, data collection procedures, and the data analysis plan. Finally, I discuss issues of trustworthiness and ethical procedures in terms of the intentional and unintentional conduct that influences trust relationships in research.

Research Design and Rationale

I examined the work-life balance experiences of women in tenured and tenure-track positions, focusing specifically on women's underrepresentation in engineering academia. Using the basic qualitative study approach (Merriam & Tisdell, 2016), I examined the shared experiences of participants in order to seek explanations of their experiences—in this case, the underrepresentation of tenured and tenure-track women engineering educators—and I identified themes that represented possible factors influencing such experiences. Operating within the basic qualitative research approach, I employed an abbreviated version of Seidman's (2006) interviewing technique in which I

conducted only one interview with each participant. I devised the interview protocol based on the research question: What are the experiences of tenured and tenure-track women engineering professors regarding family formation, child-raising, and the tenure process?

Among the six types of qualitative research described by Merriam and Tisdell (2016)—basic qualitative study, phenomenology, grounded theory, ethnography, narrative analysis, and critical qualitative research—basic qualitative study was ideal for this study. Merriam and Tisdell asserted that while all qualitative research types involve the understanding of experiences, each possesses an extra dimension that makes it distinct. In the basic qualitative study, the researcher focuses on examining how participants make sense of their experiences; and while this approach might inform practice, its aim is to expand knowledge (Merriam & Tisdell, 2016). By contrast, the phenomenological approach "describes the meaning for several individuals of their *lived experiences* of a concept or a phenomenon" (Creswell, 2007, p. 57). This approach focuses on the shared experiences of a group of individuals with the objective of reducing individual experiences of a phenomenon to a broader account of the experience common to a group.

Merriam and Tisdell (2016) distinguished between phenomenology as a particular approach to qualitative research and its more general characterization as a philosophy that motivates the qualitative research paradigm. They described the main undertaking in a phenomenological study as discovering the *essence* or basic meaning of an intense human experience. In order to explore the intricate dimensions of the lived experience, Merriam

and Tisdell emphasized the researcher's ability to bracket any biases or assumptions. In doing so, researchers explore their own experience with the phenomenon through a process called *epoche*, which requires that the researcher refrain from all judgment (Merriam & Tisdell, 2016). Merriam and Tisdell described two strategies unique to phenomenology: (a) *phenomenological reduction* (the process of repeatedly revisiting the essence of the experience to find deeper meaning) and (b) *phenomenological horizontalization* (the process of treating all data as having equal value during the initial analysis stage). The aim of the research was to avoid reducing individual experiences in favor of identifying a shared experience or phenomenon, even if it was likely that the study's results would yield some common experiences among participants.

In grounded theory, the researcher moves beyond description and focuses on the development of new theory based on events and existing documents. Although interviews are conducted, sample sizes are larger, ranging from 20 to 60 participants (Patton, 2015). As in all qualitative research, in grounded theory, the researcher is the primary data collection instrument; however, grounded theory is regarded as an exploratory method of research, enabling the researcher to use either qualitative or quantitative data to conceptualize latent patterns through a process of constant comparison (Merriam & Tisdell, 2016). Merriam and Tisdell described this type of qualitative research as one from which a theory emerges from or is *grounded* in the data, with the theory characterized as being substantive (based on real-world situations), rather than formal theory. Because the primary focus of this study was on examining how participants make

sense of their experiences, as opposed to developing a new theory, grounded theory, which entails use of a larger sample size, was not a suitable approach.

Emerging from cultural anthropology—where the researcher lives among participants over a lengthy period of time in order to observe the shared patterns of behavior, beliefs, and language—ethnographic research involves the researcher becoming a "participant observer" with an insider view (Patton, 2015). Ethnography necessitates that the researcher be "immersed in the day-to-day lives of the people and observe and interview the group of participants" (Creswell, 2007, p. 68). Merriam and Tisdell (2016) described the highly interactive nature of ethnography wherein the researcher's observations are made from the perspective of participants. Focusing on sociocultural interpretations, ethnography is distinct among the other types of qualitative research by virtue of its fieldwork component, with researchers keeping a fieldwork journal as a way to record introspective experiences while in the field (Phillippi & Lauderdale, 2017). Similar to phenomenology and narrative analysis, ethnography is not defined by the unit of analysis but rather the focus of the study, using narrative interviews and artifact analysis (Patton, 2015). Because ethnography requires that the researcher have direct observation of participants over a prolonged period of time in the natural setting, this approach was not useful for this study.

A variation on ethnography is autoethnography. Bochner and Ellis (2016) offered a comprehensive view of autoethnographic research methodology in human science, describing the approach as involving the writing of lives and the telling of stories. Although the theme of experience, whether it involves a single person or a community of

people, is common among qualitative approaches, the autoethnographic approach is designed to use the researcher's first-hand knowledge via the insider perspective (Patton, 2015). This type of study includes the researcher's own personal interpretations of motivations, culture, and specific challenges (Patton, 2015). Researchers using this design do not seek to understand the issues behind any particular problem.

Although the narrative analysis approach involves use of in-depth interviewing as a means of weaving together events, it is intended to capture the experiences of perhaps only one or two individuals (Patton, 2015). The narrative approach is also meant to capture specific and unique experiences, weaving sequences of events to create a cohesive story, as opposed to merely understanding the experiences of the individuals (Creswell, 2007). In narrative analysis, the researcher reports individual experiences by "chronologically ordering (or using *life course stages*) the meaning of those experiences" (Creswell, 2007, p. 54). Merriam and Tisdell (2016) declared the human experience to be at the heart of narrative analysis and emphasized storytelling as a means for understanding the experience. Narrative analysis is ideal for constructing a persona—for explaining culture through the lens of a persona. The aim of this study, however, was to examine and understand the experiences of women engineering faculty and how such experiences interact to give personal meaning. Because it focuses primarily on the sequencing of individual experiences, narrative analysis was not a good fit for this study.

In examining various approaches to qualitative research, three methods (basic qualitative study, case study, and phenomenology) appeared to be applicable, given the focus of the central research question: What are the experiences of tenured and tenure-

track women engineering professors regarding family formation, child-raising, and the tenure process? A case study involves a deep understanding through multiple types of data sources. Case studies can be explanatory, exploratory, or descriptive of an event (Patton, 2015). However, in case study, inquiry is limited to a shared location for the group under study. Case studies are largely focused on organizations and events; hence, they are restricted to specific settings and involve what Creswell (2007) deemed a bounded system, also referred to as a *case*. Since this study recruited participants from multiple locations, in order to identify experiences and determine underlying challenges felt by tenured and tenure-track women engineering faculty regardless of institution, the case study approach was not be suitable.

Since the aim of this study was to explore the phenomenon of under-representation of tenured women engineering professors, the phenomenological approach appeared to be a promising contender. While all qualitative research focuses on the constructions of how individuals experience a phenomenon, phenomenology explicitly seeks meaning, structure, and the essence of the *lived* experience (Patton, 2015). Descriptions of *living in the moment* and eidetic reduction, a process of abstraction wherein the researcher tries to reduce the phenomenon into its necessary essences, are hallmarks of phenomenology (Patton, 2015). Phenomenology differs from basic qualitative inquiry in that it digs below the surface of participants' perceptions of the phenomenon to uncover individuals' meaning making (Patton, 2015). Phenomenology is a respectable approach for research that aims to unearth the *essence* of a shared experience, one that is emotional and intense, requiring the researcher to seek

understanding of the phenomenon through the eyes of participants (Merriam & Tisdell, 2016). This level of inquiry requires in-depth interviewing to glean the deeper meaning in the underlying structure of a phenomenon (Merriam & Tisdell, 2016). By contrast, the aim of the basic qualitative study is to understand how individuals make sense of their experiences so that the researcher may improve the condition of those individuals. While the purpose of the basic qualitative study is to uncover strategies and best practices, phenomenology does not examine such strategies and practices (Merriam & Tisdell, 2016).

Given that this study was designed to explore the meaning of an experience—in this case, the experience is the impact of family formation and child-raising on women engineering professors' tenure—explicitly for the purpose of improving a particular condition, the basic qualitative inquiry was the most suitable approach. This approach explores how people interpret their experiences and what meaning they attribute to those experiences (Patton, 2015).

Role of the Researcher

Having worked in the engineering educational domain for over 20 years, the impetus for this study came from a personal desire to encourage more women to pursue non-traditional career roles. My workplace afforded me opportunities to interact with women engineering faculty, both tenured and tenure track. It was through my personal close friendships with women engineering faculty that I became aware of how few of my colleagues met the description of the child-rearing participant that I sought for this study. Counted among my women engineering colleagues were those with whom I have long

interacted via professional societies and organizations dedicated to advancing the prominence of women in engineering. These organizations include WEPAN, a national nonprofit consortium of advocates from about 200 universities, colleges, government agencies, and Fortune 500 companies ("The WEPAN Network," n.d.), and the Women in Engineering Division (WIED) of ASEE.

While I may be uniquely equipped to conduct this particular research study, given both my work experience and professional networks, the topic itself has not been explored to any extent by any researcher. Moreover, institutions and organizations that have a long-standing record of promoting the advancement of women in engineering more often tackle the problem of women's under-representation in engineering through the lens of K-12 outreach strategies; and few programs are designed to support women in the engineering professoriate. The evaluation of existing research on women in engineering revealed a gap in literature concerning women engineering faculty for whom the role of primary caretaker of children sharply contrasts against the path to tenure.

In qualitative research, Patton (2015) referred to the researcher as the key instrument, wherein data is reconciled through the researcher with the researcher's interpretations intrinsically interwoven into prior experiences and background. Hence, it is critical for qualitative researchers to acknowledge their assumptions and biases early in the study and maintain control of such biases throughout the conduct of research. For this study, I indicated that my biases come from my work experience in engineering education. Specifically, as a founding director of a women-in-engineering program at a state university, such biases have shaped my perceptions of the topic under study. To

limit the impact of biases, I adopted the method of bracketing (Patton, 2015), known as phenomenological reduction, in which the researcher suspends judgments of the topic by consciously bracketing them. To maintain impartiality, none of the participants selected for this study included those who are subordinate to me. Further, to reduce respondent bias—specifically reducing participants' tendency to respond in a way that they believe is socially acceptable—I phrased interview questions to support socially unacceptable responses. This was achieved by using indirect questions, such as asking participants what a third party might think, thereby allowing participants to project their feelings onto a third party but still give authentic responses. During the course of listening to participants' responses, I recorded all emergent ideas in an electronic journal. Referred to as reflexive journaling, this method prevented me from relaying any sentiments that might influence the interview. In this way, I bracketed my biases and at the same time, I approached the topic as someone new to it.

Methodology

This study was designed to capture the experiences of 12 women engineering professors. For this study, I used an abbreviated and modified version of Seidman's (2006) three-stage progressive interview technique. I incorporated the in-depth interviewing model by blending the attributes of all three stages into one succinct interview. The research subjects are referred to as *participants*, a term that Seidman (2006) used to "capture both the sense of active involvement that occurs in an in-depth interview and the sense of equity" for developing a relationship through the interviewing process (p. 14). The three-stage interview format enables the researcher to determine the

context and breadth of participants' experiences and allows participants opportunity to recreate details of their experiences. Finally, it asks participant to reflect on their experiences.

Participant Selection Logic

The sample frame for this study was limited to 12 tenured and tenure-track women engineering faculty who are employed at brick-and-mortar, four-year institutions of higher education. I limited this study to include women faculty who work at a university since community colleges have a different tenure process and are largely composed of adjunct professors. Further, no participants were from online universities due to distinct differences between online and brick-and-mortar institutions.

Because qualitative research is concerned with deriving meaning, as opposed to developing a generalized hypothesis, the sample size for qualitative research is much smaller than for quantitative research (Patton, 2015). Patton (2015) stressed that samples be large enough to ensure a diversity of perspectives but not so large as to result in data redundancy. Hence, saturation, the point at which adequate data has been collected for a detailed analysis, is a major consideration in determining sample size (Glaser & Strauss, 1967). For the basic qualitative study, Patton (2015) recommended 10 participants but also encouraged a reduction of the sample if saturation was reached prior to assessing the 10 participants. Given the sheer under-representation of women engineering faculty in general, no more than 10 participants were expected to be involved in this study.

Instrumentation

This basic qualitative study approach used a semi-structured interview protocol (see Appendix), involving pre-formed questions that initiate and probe participants for responses focused on specific themes in an approach suggested by Rubin and Rubin (2012). Operating within the basic qualitative research study, this study employed a modified version of the Seidman's (2006) three-stage interviewing technique. Seidman's (2006) approach involves three formal interviews: (a) the first stage, deemed *focused life history*, asks participants to share their life experiences in the context of the research topic; (b) the second stage, deemed *details of experiences*, offers participants opportunity to reconstruct experiences in detail; and (c) the third stage, deemed *reflection on the meaning*, guides participants to reflect on the significance of their lived experiences and consider how such experiences shaped their lives. For this study, the three stages were collapsed into one interview while still allowing participants adequate time to reiterate and reflect on their experiences. It was important to preserve the three stages of Seidman's (2006) interviewing technique, which was designed to enable the researcher to determine context and breadth of responses and allow participants to recreate details of their experiences and reflect on those experiences.

With hopes of better understanding the experiences of women engineering faculty, this study inquired about participants' life experiences with family and friends by asking participants to share personal details: "Tell me about your commitments outside of work." It also solicited participants' perceptions of professional work life and academic climate using probing questions such as, "What are some issues that have come up

regarding your job?" and "How did you or others respond, address, or mitigate issues?" In inquiring about life experiences in the context of life history, the interview included "why" and "how" questions to encourage participants to recount important life details that inspired them to pursue a career in engineering.

I constructed questions that attended to two women's ways of knowing positions (Belenky et al., 1986) that emphasized *procedural knowledge*; these are *separate knowing* and *connected knowing*. Exploring the epistemological beliefs of women engineering professionals offered a chance to both examine women's ways of knowing in a context where the male-dominated culture of engineering has historically insulated women—beginning with the formative school years and continuing through the graduate school years—and at the same time, learn about what steers women away from important educational experiences and training needed to enter the engineering profession. This blended one-interview format incorporated all three stages of Seidman's (2006) interview format; and within these stages, two women's ways of knowing positions (Belenky et al., 1986) were explored through a series of questions that reflect those positions.

Stage one questions: Focused life history. At this stage in the interview, questions were designed to solicit participants' early experiences of childhood and the formative school years, recollecting memories of early experiences of home, community, and school life. Questions inquired about how participants perceive words or phrases, whether certain words or phrases influenced decisions, and how such decisions affected progress in their chosen career pathway. At this stage, inquiry was focused on ascertaining if and how early experiences may have affected participants' decisions for

pursuing an engineering career pathway and how these experiences mediated the effects of procedural knowledge.

Stage two questions: Details of experience. During this stage, participants were encouraged to narrate the details of their life experiences. Participants were asked to expand on their responses conveyed via stage-one questions. Specifically, second-stage questions attempted to draw out associations to the two procedural knowledge positions of women's ways of knowing (Belenky et. al., 1986). The first is separate knowing, particularly as women may express lack of confidence in their own voice and concerns about developing themselves as professionals at the expense of others (e.g., their children, their family); here, women may convey a separation from emotions of self. The second is connected knowing, in which women's sense of voice arises, but women may continue to feel a sense of modesty and display inward listening by watching others to avoid jeopardizing connections. In this position, women's knowing is based in the ability to empathize. This stage of the interview offered participants a chance to disclose their experiences of listening to and incorporating the opinions and perspectives of others. Main questions and several sub-questions were developed for this stage for the purpose of drawing out responses for which I could listen for procedural knowing.

Stage three questions: Reflection on the meaning. The final stage of questions was designed to solicit participants' reflections on the meaning of their experiences and addresses their personal (emotional) and professional (intellectual) connections of work-life balance, both within the identity of mother and of engineering faculty. These questions attended to a reflection of procedural knowledge—wherein women are able to

create knowledge through observation and analysis—and constructed knowledge—wherein women are able to develop a solid narrative of *self* (Belenky et al., 1986). Regarding procedural knowing, Belenky et al. (1986) found that women consistently present higher preference for connected knowing but lower preference for separate knowing. This stage in the interview asked participants to make sense of their experiences by having them examine how certain dynamics and elements in their life experiences intersected. Even though participants are likely to frame aspects of their experiences in terms of meaningful events, Seidman (2006) differentiated these meaningful events conveyed during first- and second-stage interviews from the third-stage interview in that third-stage interview questions are posed in the context of the first- and second-stage interview responses. The attention of *meaning* is not focused from the point of view of the participant but rather, in the third-stage interview, the interviewer drives the responses. Hence, third-stage interview questions were phrased to solicit a future orientation, such as, "Given what you have shared about your experiences with not having a solid faculty mentor, what advice can you offer?" or "How do you see yourself in terms of supporting other women in this field?"

Finally, additional open-ended questions included the concepts of *w*ork-life balance and *chilly climate*. An example of a work-life balance question is: "How do you balance work, home life, and personal interests with professional work?" The associated probing question is: "Give me an example of when home life interferes with professional work." Although the concept of chilly climate is well-documented in various studies on women in non-traditional career roles, to avoid bias in research, the concept of chilly

climate is modified and expressed as *work environment*. An example of an open-ended question for the concept of work environment is: "What has your experience been in engineering?" The associated probing question is: "Many women leave engineering. What keeps you here?"

The interview protocol included questions about the childhood years and how certain life events influenced participants' career decisions. The protocol included sub-questions about work-life balance, navigating the tenure process, finding time for family formation and children, and strategies used to offset large commitments of time for teaching and research. This study also explored whether women's experience with leaves of absence (such as maternity leave or other types of hiatus) and workplace climate affect progress toward achieving tenure. Content analysis included both the conventional approach (wherein coding categories are derived from the data) as well as the summative approach (wherein counting and comparisons of keywords are done).

Procedures for Recruitment, Participation, and Data Collection

The recruitment of participants was facilitated through email invitation, sent via three professional network listservs: wepan-l@purdue.edu, maintained by WEPAN; psw_sec@asee.org, maintained by ASEE PSW; and women_div@asee.org, maintained by ASEE WIED. Because I am a member of each of the three professional societies, I was able to send the participant recruitment announcement via email to the WEPAN, ASEE PSW, and ASEE WIED listservs. The email announcement included a description of the research study along with a request for potential candidates to self-identify as women engineering tenured or tenured-track faculty with children and provide

information about their current employment status. To provide full details of the study, the informed consent was attached to the announcement. Interested candidates, who met the self-reporting requirements and submitted their consent to me. Once the initial contact was made, an interview appointment was scheduled for each participant. Using Microsoft Outlook, a meeting request was be sent to each participant, indicating the interview date, time, and modality. To provide greatest flexibility, participants were offered the option of interviewing via phone or via web-conferencing. For web-conferencing, Skype or Zoom, commonly used video-conferencing platforms, were offered. I did not use the video feature of the web-conferencing software and only used the audio feature to record the interviews. To protect each participant's identity during the recruitment and interview scheduling, I communicated with each participant individually; and I did not send any group email messages.

As part of the full disclosure of the nature of the research, prior to the interview, I reviewed the informed consent process (including the study's purpose, implications, and expectations) with each participant. An explanation of research confidentiality, including the use of pseudonyms, was provided in detail. The interview, incorporating Seidman's three stages, was 60–90 minutes in duration, including the initial stage-one reflective questions. The interview was conducted and completed within three weeks of the initial contact. The transcription of interviews was completed using software and manually edited for errors; this was completed simultaneous to the interviews. To reconcile any discrepancies of the interview, participants were asked to review the interview transcript and provide feedback within one week of receiving the transcript. As an incentive,

participants received a $50 gift card. All data, including informed consent forms, audio recordings, transcripts, participant feedback, and field notes were saved to a password-protected folder, located on an external hard drive, which itself is password-protected.

Data Analysis Plan

This study utilized the in-depth interviewing technique, as I spent time interpreting transcript data in order to understand the meaning behind participants' experiences. A modified qualitative data preparation and transcription protocol, based on the recommended field methods of McLellan, MacQueen, and Neidig (2003) for preserving the morphological naturalness—meaning that the word and commentary forms and punctuation in the transcript captures as close as possible the original speech—was be used. This study relied on procedures described by Saldaña (2009). In reviewing transcript data, I assigned codes, which are words or short phrases that symbolically represent qualities of the text-based data collected from the interviews. Saldaña (2009) described coding as a heuristic form of research in that "the majority of qualitative researchers will code their data both during and after collection as an analytic tactic, for coding is analysis" (p. 9).

Because of the descriptive and interpretive nature of this qualitative study—and to completely avoid researcher confirmation bias—a priori codes were not used. This allows the researcher to experience in-the-moment reactions and removes the natural tendencies to lean on prior knowledge that may cause the researcher to filter information. Building codes during analysis is an inductive process. Codes emerge naturally and are established

based on the context of participants' responses. Analysis was done using the emergent coding approach.

Transcript data was reviewed and coded in sequence, with a first cycle coding process to involve single to full-sentence to entire pages of text—with *emergent codes* developing from these initial ideas—and second cycle coding to involve a refining and reconfigurations of the first cycle codes. Saldaña described coded datum as one-word capitalized codes, also known as *descriptive codes*, while codes developed directly from participants' own words and rooted in their own language are placed in quotation marks; these are known as *in vivo codes*. After codes are developed, a search for patterns in the coded data will help to organize groups of codes into *categories* or *families* (Saldaña, 2009). These *categories* or *families* are developed based on the researcher's own cataloging reasoning and perceptions of participants' experiences. This process of categorizing or grouping is highly dependent upon the researcher's own background and intuitive sense of issues faced by the advocated group. While word-frequency counts were performed, it is noted that each word may not exactly represent a category or unit of analysis. To test for consistency in word usage to establish in vivo codes, a *key word in context* (KWIC) identified sentences in which the word was used (Saldaña, 2009).

While Saldaña (2009) laid out a highly structured repertoire for coding, it is important to recognize that the researcher's relationship with participants—which may develop during the interview—influences the data collection, documentation, and coding of data. In this, bracketing, or the self-reflective process recommended by Creswell (2007), is significant to controlling bias during the data analysis phase. It is easy to

become too involved, and hence data analysis must be structured so that the amounts of data, also known as the *data corpus* (Saldaña, 2009) will not exceed the most salient portions that are significant to addressing the research questions. While Saldaña (2009) indicated that it is not uncommon for qualitative researchers to summarize about one-half of the total transcribed record leaving the other half for rigorous analysis, he also cautioned against deleting material that might contain meaningful units of data. Saldaña recommended that the researcher focus on collecting and coding quality data, notwithstanding the amount of data.

Issues of Trustworthiness

Quantitative research relies on measures of reliability and validity to evaluate the effectiveness of a study; however, qualitative research must be evaluated by its trustworthiness, a term that represents several concepts including, credibility, transferability, dependability, and confirmability (Patton, 2015). The credibility or truth-value in qualitative research is analogous to internal validity in quantitative research. Credibility inquires whether the conclusions sufficiently illustrate participants' perspectives and whether they faithfully represent the phenomenon. To strengthen the trustworthiness of this research study, for credibility, this project employed transcript review. Participants were asked to review and provide feedback of the interview transcripts. Transcript review ensures accuracy of the interview results (Patton, 2015). Additionally, prior to and after the interviews, I used memoing (Patton, 2015) to record my observations of participants and preliminary interpretations of participant responses; and this helped me to track noteworthy themes emerging across participants.

Transferability, on the other hand, is analogous to the concept of external validity in quantitative research. In transferability, the researcher attempts to determine whether the study results can be transferred to other contexts (Patton, 2015). For this study, the thick rich descriptions from participants' experiences offered ample details, which I used to describe the distinct context for the phenomenon. This was achieved using detailed field notes—which served as a record my perspectives and sentiments as they evolved through the course of the interview stage and throughout the analysis stage—as well as a reflective journal of my research experience. This method allows for triangulation, strengthening the overall rigor and trustworthiness of the findings (Patton, 2015). These approaches offer an adequate account of the phenomenon for improving the transferability of the study's findings.

Dependability refers to the consistency of the study's results over time; and it is analogous to the concept of reliability in quantitative research. The researcher must be able to justify the permanently changing context in which the research is conducted and describe how such changes affect the research study. Patton (2015) referred to this as *progressive subjectivity*. My research journal served as an audit trail, recording what I had initially expected to discover from the study, describing my biases, and then noting my reflections about how my earlier interpretations have changed.

Lastly, confirmability establishes whether the study is free of bias and prejudice (Patton, 2015). I documented specific tactics and methods so that they can be checked and re-checked throughout the study. Some techniques to strengthen confirmability include: prolonged engagement and persistent observation (building trust with

participants), peer debriefing, negative case analysis (revising initial hypotheses until all cases fit), triangulation, and clarifying (once again, I commented on past experiences, biases, prejudices, and orientations that may influence interpretations of the study). In this study, I asked participants to review a transcript of their interview for accuracy.

Ethical Procedures

Walden University requires that researchers submit a research study protocol to the Institutional Review Board (IRB) for Ethical Standards in Research; this is to ensure that all Walden University research complies with the institution's ethical standards, including any federal regulations. I sought and received IRB approval (Approval #04-18-18-0061320) before collecting any data. The review of the research study protocol included a review of the survey instrument—in this case, the interview protocol—and verification that I would maintain the confidentiality of the study participants, as well as all email messages and letters of invitation to participants. From a data protection and privacy issue, all participants were provided with informed consent, which was developed with clear and concise language to describe both the type of data collected and the planned research use of the data. Participants' confidentiality was communicated via the announcement for recruiting participants and prior to the start of the interview. I reviewed the informed consent with each participant and offered time for them to ask questions. Each participant was assigned a pseudonym for use in the study's results.

Ethical Concerns

Research ethical concerns involve requirements on the part of the researcher to protect the dignity of participants and the publication of the study findings. For this study,

the recruitment of participants was facilitated via three different professional society list-servs: wepan-l@purdue.edu, women_div@asee.org, and psw_sec@asee.org. Because I am a member of these organizations, the invitation email was sent by me. This qualitative research study used pseudonyms to maintain the confidentiality of participants. Data was stored electronically in a password-protected folder on an external hard drive as well as the hard drive of my personal computer; data was not stored to cloud storage, which is susceptible to hacking. To ensure that data is not lost or compromised, due to computer failure, data was synchronously backed up on the external hard drive.

Treatment of Data

For this study, data protection and privacy issues were considered. Data was acquired via various methods (e.g., email, telephone, Skype or Zoom web-conferencing). Data was stored on an external hard drive and the hard drive of my personal computer in a password-protected file. All audio recordings were encrypted with a password. Transcripts of interviews were password-protected. Because the handling of personal data is a major concern in all types of research, this paperless approach, which included password protection and data encryption, rendering access difficult, offered the highest level of protection. Once the study is completed, all data will be maintained in an electronically secured fashion. After a period of 5 years, all data related to this study will be deleted from both the computer hard drive and the external hard drive.

Summary

In exploring the experiences of women engineering professors via this basic qualitative study, I addressed a research question involving the life and educational

experiences of tenured and tenure-track women engineering professor. I explored their perceptions of the climate of engineering academia and their experiences of work-life balance as it regards the impact of family formation, child-raising, and the tenure process. In reviewing the options for qualitative research approaches, given the highly descriptive and naturalistic feature of the basic qualitative research approach, I determined that a modified version of the three-stage interviewing technique (Seidman, 2006) was the most befitting method for this study. Beyond the issues of trustworthiness, ethical considerations are recognized as important to the success of the research study; so, I developed an organized plan for maintaining and controlling data security and access. In Chapter 4, I presented the study findings, including data collected from the participant recruitment and selection phase, and demographics of participants. To support the conceptual framework of the study, I included participants' quotes that were representative of each theme generated in the transcript analysis. I selected quotes that possessed an emotive quality to best illuminate participants' experiences.

Chapter 4: Results

The purpose of this qualitative study was to examine the work-life balance experiences of tenured and tenure-track women engineering professors in the United States who have children. The research question was, What are the experiences of tenured and tenure-track women engineering professors regarding family formation, child-raising, and the tenure process? Among U.S. women who earned engineering doctorates, only 15.7% held tenured or tenure-track engineering faculty positions (ASEE, 2015). The dearth of women engineering professors, along with the current literature relating women's work-life balance challenges to the shortage of women in the STEM professions—coupled with data regarding the impact of child-bearing patterns on women's ability to achieve tenure (Mason et al., 2013)—suggested that there may be ways to mitigate some of these challenges. A key finding from the research on the baby lag and baby gap revealed that the period of work toward tenure coincides with the prime child-bearing years (Mason et al., 2013). I used data from the interviews of 12 women engineering professors to provide an understanding of how work-life balance is a fundamental structure of the tenure experience. These findings may be useful to higher education administrators to substantiate efforts aimed at supporting women in tenured and tenure track engineering positions or to catalyze initiatives designed to raise awareness of women's underrepresentation in engineering academia.

Setting

I coordinated the participant recruitment in a manner I considered noncoercive. I sent an electronic announcement for recruiting participants via three professional society

listservs; two were associated with national organizations and one with a regional organization: wepan-l@purdue.edu (maintained by WEPAN), women_div@asee.org (maintained by ASEE WIED), and psw_sec@asee.org (maintained by ASEE PSW). I provided each participant with an incentive of $50 in the form of a gift card; I considered this amount to be nominal considering that participants were engineering faculty. Because I am a member of the three professional organizations, I excluded individuals who have a relationship with me. Further, to maintain impartiality, none of the participants selected for this study were subordinate to me. I disclosed my roles within each of the three organizations on the consent form and made it clear that my role as a researcher with Walden University was separate from my membership in the three organizations.

To protect participants' identities during the recruitment and interview scheduling stages, I communicated with each participant individually, and none of the participants was included in any one e-mail to all. While I used Zoom (a web-conferencing platform) for the interviews, only the audio-recording feature was enabled. I interviewed each participant in her own environment, scheduling the interviews to accommodate each participant's respective time zone. To strengthen the trustworthiness of this research study, I incorporated a transcript review process in the data analysis plan. As suggested by Patton (2015), I asked participants to review the transcript and provide feedback to ensure accuracy of the interview results.

Demographics

From a total of 50 women who responded to the electronic announcement for recruiting participants, 48 met the criteria for participation. After multiple exchanges with respondents, in which I verified eligibility and considered availability for a 60–90-minute interview, I selected 10 women who submitted the informed consent. Due to scheduling issues and time conflicts, five of the original 10 participants rescinded their participation. Within a period of 1 month—simultaneous to when interviews were being scheduled—seven additional women from the pool of respondents submitted the informed consent. Because of the unpredictability of participant early withdrawal and the possibility of further attrition, I invited several women to serve on a wait list, with each agreeing to take the spot of any participant who needed to withdraw from the study. From a total of 16 scheduled interviews, I selected a total of 12 women to be participants. It seemed that participation in this work-life balance study itself required considerable commitment on the part of many respondents.

Demographics of Respondents

Due to women's underrepresentation in engineering in the United States, both as practicing professionals and as tenured and tenure-track faculty with children—a group considered a hidden population (National Academies, 2010)—this study's recruitment required a national search. Given the unique nature of this study's population, it is critical to report demographic information about the respondents, including institution type—denoting the "Basic Classification" descriptions (Carnegie Classification of Institutions of Higher Education, n.d., para 3)—geographic regions where institutions were located,

and respondents' PhD discipline. Of the 48 initial respondents, 27 (56.3%) were from the Western region of the United States (see Table 1). With respect to institution type, 21 (43.8%) were from R1 (doctoral universities—highest research activity) institutions (see Table 2).

Table 1.

Respondents' Geographic Region

Region			
Midwest	Northeast	South	West
8	6	7	27

Table 2.

Respondents' Institution Type

Institution type					
BCASF	M1	M2	R1	R2	R3
1	14	2	21	8	2

Note. *BCASF* (baccalaureate colleges: arts & sciences focus); *M* (master's colleges and universities): 1 =larger programs, 2 =medium programs, 3 = smaller programs; *R* (doctoral universities): 1 = highest research activity, 2 =higher research activity, 3 = moderate research activity.

All respondents had a PhD in engineering. The distribution of PhDs was spread across nine disciplines such as civil and mechanical engineering, with no majority in any one discipline. Ten respondents had PhDs that blended two or more disciplines, such as theoretical and applied mechanics. Of the 48 initial respondents, 64.6% (n = 31) came from doctoral universities, suggesting that those whose primary role was research were more interested in this study than those whose primary role was instruction.

Table 3.

Respondents' PhD Discipline

Engineering discipline	No.	%
Biomedical engineering	3	6%
Chemical engineering	5	10%
Civil engineering	6	13%
Civil & environmental engineering	3	6%
Computer engineering, computer science	4	8%
Electrical engineering	4	8%
Environmental engineering	4	8%
Industrial engineering	3	6%
Mechanical engineering	6	13%
Other engineering, related discipline	10	21%

Demographics of Participants

From the 48 respondents, 12 submitted the informed consent and completed a 60–90-minute interview. Table 4 displays demographics of participants, including their PhD discipline, academic rank, institution type, years employed at the institution, geographic location of institution, and number of children. To maintain research confidentiality, I assigned each participant a pseudonym (month of the year).

Table 4.

Participants' PhD, Rank, Institution Type/Years/Region, Children

Participant (Pseudonym)	PhD (Discipline)	Rank	Institution (Type)	Institution (No. years)	Region	Child(ren) (No.)
January	Industrial engineering	Associate professor	R1	9	Midwest	1
February	Industrial engineering	Associate professor	R2	12	South	2
March	Electrical engineering	Professor	R1	28	West	2
April	Chemical engineering	Assistant professor	R1	4	South	1
May	Civil & Environmental engineering	Assistant professor	M1	6	Midwest	2
June	Civil engineering	Professor	R1	15	West	1
July	Computer engineering	Assistant professor	M1	2	West	1
August	Environmental engineering	Professor	R1	15	South	1
September	Electrical engineering	Professor	R1	23	West	4
October	Biomedical engineering	Assistant professor	M1	1	West	2
November	Mechanical engineering	Professor	M1	10	West	2
December	Chemical engineering	Assistant professor	R2	2	Midwest	1

Note. *M* (master's colleges and universities): 1 = larger programs; *R* (doctoral universities): 1 = highest research activity, 2 = higher research activity.

Three participants (January, July, and November) were foreign-born and received their Bachelor of Science degree in engineering from a foreign institution; they described their undergraduate school years as being without incident. By contrast, the nine American-born participants described their undergraduate school years as being a time of enlightenment when they recognized their unique presence in a male-dominated field. January described her race as Asian, and July described her race as Hispanic. The 10

other participants (83.3%) described their race as White. Two participants described their partnership status as single and divorced, and 10 said they are married. With regard to number of children, six participants had one child, five participants had two children, and one participant (September), a full professor, employed at her institution for 23 years, had four children. Eight participants' children were currently under the age of 10 (either in preschool or elementary school). December's child was an infant (less than one-year old). Two participants' (March and September) children were young adults over the age of 18, but their children were under the age of 18 when they sought tenure.

With respect to geographic location, six participants were from the West, three from the Midwest, and three from the South; there were no participants from the Northeast region of the United States (see Table 4). Two participants were associate professors, five (42%) were assistant professors, and five (42%) are full professors. With respect to the institution type, six participants (50%) were employed at R1 (Doctoral Universities—Highest research activity) institutions, four participants (33%) were employed at M1 (master's colleges and universities—larger programs), and two participants (17%) were employed at R2 (doctoral universities—higher research activity). The average number of years that participants were employed at their respective institution was 10.6 years. Four participants were employed for fewer than 5 years at their respective institution, three in the range of 6 to 10 years, three in the range of 11 to 15 years, and two for over 20 years. The two participants employed for over 20 years at their universities were March (28 years) and September (23 years).

Data Collection

This study employed a modified version of Seidman's (2006) three-stage interviewing technique. Since the purpose of study involved a marginalized population, in this case, tenured and tenure-track women engineering professors who have children, the study was expected to use a non-random, purposeful sample of 8 to 10 participants. Due to the experience with participant early withdrawal during the interview scheduling phase (with five participants withdrawing after the submission of the informed consent)—and to prepare for the possibility that additional attrition might reduce the sample size—I decided to retain 12 participants who expressed a great level of interest and who submitted the informed consent during the early weeks of the recruitment phase. Operating within the basic qualitative research approach, this study employed an abbreviated version of Seidman's (2006) interviewing technique such that only one interview was conducted. The data collection instrument was a semi-structured interview protocol (see Appendix), involving pre-formed questions that initiated and probed participants for responses focused on specific themes. The interview itself was based on the in-depth qualitative interviewing approach developed by Rubin and Rubin (2012), which included how to ask probing questions and how to frame sub-questions to add depth and facilitate a natural meaningful interaction with participants.

Each 60–90-minute synchronous (real-time) interview was recorded using the audio-recording feature of Zoom (a web-conferencing platform), which also allowed participants the use of a web camera; however, video was not recorded at my suggestion. The audio recordings, as well as the interview transcripts, were stored and secured within

an external hard drive and personal computer hard drive. Data was encrypted and password-protected; and my home office is where all data is stored. While there were no major deviations from the data collection plan that was presented in Chapter 3, I used the video function of Zoom as it allowed me to visually observe participants and them to experience my own engagement through listening and doing impression management, including observing their body language and facial expressions. I used the memoing to record my observations. Geographical dispersion and physical boundaries of research often reduce the possibility of conventional face-to-face interviews; and so, the use of web-conferencing technology allows researchers the ability to access participants anywhere anytime. The visual-recording feature of Zoom was disabled during the interview, but the web camera allowed the interview to be comparable to that of an on-site in-person interview due to presence of non-verbal cues, such as body language and facial expressions (Sullivan, 2012). The web camera allowed participants to see me, too. Overall, using a high-bandwidth connection via Zoom was a good medium for conducting an in-depth interview; in essence, it was a face-to-face interview.

The only unusual circumstances encountered during the data collection was an occasional loss of internet connection for one participant, August. Since the interview was not expected to last more than 60–90 minutes, I proceeded through the questions, notating where there was a loss in internet connection. For parts of the interview that were unclear due to loss of internet connection, I received clarification from the August from her edits of the interview transcript.

I sent the transcripts to all participants. Of the 12 participants, five provided edited copies (with minor revisions) while seven approved the transcript and asked that I redact all personal and identifiable information. I assured all participants the informed consent is honored, that their identity would be kept confidential, and that no personal information would be used in any part of the published results.

Data Analysis

I used a transcription software to convert the audio data to text and then went through the text to manually edit, correcting any auto-transcription errors. Using a qualitative data preparation and transcription protocol (University of Washington, 2007), I formatted the interview transcript, applying standard formatting conventions such as denoting comments from participants with the label "P" (at the left margin) and "I" for the interviewer. If there were incorrect pronunciations of words or words that I had difficulty understanding, I included the correct word in brackets and placed a forward slash behind the open bracket and another slash in front of the closed bracket. For some participants, there were segments that I could not hear; and I denoted this with the phrase "inaudible segment." To capture participants' authentic thoughts, the transcripts included slang and some inappropriate expressions and foul language.

I reviewed all interview transcripts thoroughly and made notes (using a different font color) directly under participants' responses; this was the memoing process. Memoing allowed me to get a general sense of the data. Although an initial word-frequency count was performed, it was recognized that each word may not exactly represent a category or unit of analysis. This process was abandoned so that I could re-

read the transcript and be immersed in it. Table 5 shows specific data elements for each participant's interview, interview recorded time, and the transcript word count, as generated from transcription software.

Table 5.

Participants' Rank, Interview Day/Time Zone/Time, Word Count

Participant (Pseudonym)	**Rank**	**Interview Day**	**Interview Time**	**Total Interview Time (Minutes)**	**Word Count (Transcript)**
January	Associate professor	Tues	9:00 a.m. (CST)	77.4	7,650
February	Associate professor	Tues	11:00 a.m. (CST)	60.6	6,328
March	Professor	Wed	9:00 p.m. (PST)	77.0	14,565
April	Assistant professor	Fri	3:30 pm (CST)	84.1	12,568
May	Assistant professor	Tues	9:00 a.m. (CST)	65.5	5,899
June	Professor	Wed	11:00 a.m. (MST)	78.6	13,460
July	Assistant professor	Wed	12:00 p.m. (PST)	76.4	7,468
August	Professor	Fri	9:00 a.m. (CST)	94.6	11,680
September	Professor	Fri	9:00 a.m. (PST)	89.3	11,883
October	Assistant professor	Mon	10:30 a.m. (PST)	74.9	8,519
November	Professor	Mon	1:00 p.m. (PST)	74.5	11,528
December	Assistant professor	Tues	6:00 a.m. (EST)	71.1	8,813

Shorthand labels: CST (central standard time); EST (eastern standard time); MST (mountain standard time); PST (pacific standard time).

Using the data analysis plan described in Chapter 3—including re-reading the transcript multiple times—I categorized the raw data into large groupings; this is the process of *chunking*. Thereafter, the chunks of data were reduced to clusters and then to codes; this is the process of *winnowing*. From the myriad of codes that were generated,

the process of reducing codes was repeated at least twice so that the reduction would result in a refinement of codes that were mutually exclusive and considered usable.

A first cycle coding process involved single- to full-sentence to full pages of text—for generating *emergent codes* developed from preliminary ideas—and next, a second cycle coding involved a refining of the first cycle codes. In other words, the process was repeated twice to allow time for me to reflect on my interpretations of the codes. This is the process described by Saldaña (2009) as generating coded datum as one-word capitalized codes, also known as *descriptive codes*. Some codes were developed directly from participants' own words and rooted in their own language (such as those placed in quotation marks); these are known as *in vivo* codes. After codes were developed, a search for patterns in the coded data allowed me to organize groups of codes into *theme categories* or *families* (Saldaña, 2009). These *theme categories* or *families* were based on my own cataloging reasoning and perceptions of participants' experiences. This coding method was used to expose the full range of themes and their dimensions and relationship to each other. I read the transcripts several times and went through two cycles of coding to identify codes. After identifying 33 codes I grouped them into six categories, which turned out to hold more than one theme. In the expansion of categories, a total of 14 interpretive themes emerged.

Evidence of Trustworthiness

For this basic qualitative research study—which used a modified approach combining in-depth interviewing with life-history interviewing—I examined the work-life balance experiences of 12 tenured and tenure-track women engineering faculty who

have children. On the evidence of trustworthiness, the implementation of approaches to ensure credibility, transferability, dependability, and confirmability of the data collected was consistent with that described in Chapter 3. For credibility, this project employed transcript review, allowing participants to provide feedback of the interview transcripts. Transcript review will ensure accuracy of the interview results (Patton, 2015).

For transferability, I made efforts so that the study results can be transferred to other contexts (Patton, 2015). For this study, the thick rich descriptions of the findings from participants' experiences provided detail needed to deliver a distinct context for the phenomenon. This was facilitated via the use of detailed field notes which documented my perspectives and sentiments through both the interview and analysis stage—as well as a reflective journal of my research experience. This method facilitated triangulation, strengthening the overall rigor and trustworthiness of the findings (Patton, 2015). It is anticipated that these approaches would offer an adequate account of the phenomenon to improve the transferability of the study's findings.

Dependability refers to the consistency of the study's results over time; and it is analogous to the concept of reliability in quantitative research. As the researcher, I must be able to justify the permanently changing context in which the research is conducted and describe how such changes affect the research study. Patton (2015) referred to this as *progressive subjectivity*.

Finally, confirmability establishes whether the research study is free of bias and prejudice (Patton, 2015). I documented specific tactics and methods so that they can be checked and re-checked throughout the study. Some techniques to strengthen

confirmability included building trust with participants; and I did this by sharing with them my own experiences with trying to balance family and a career. I also bracketed my biases, prejudices, and orientations that may influence the interpretations of the study.

Results

This basic qualitative study involved one research question: What are the experiences of tenured and tenure-track women engineering professors regarding family formation, child-raising, and the tenure process? The blended one-interview format incorporated all three stages of Seidman's (2006) interview format. The interview protocol included sub-questions about work-life balance, navigating the tenure process, finding time for family formation and children, and strategies used to offset large commitments of time for teaching and research. Because the study also explored whether participants' experiences with leaves of absence (such as maternity leave or other types of hiatus) and workplace climate affect progress toward achieving tenure, probes resulted in a variety of moving statements made by participants. The interview questions also allowed exploration of two women's ways of knowing positions (Belenky et al., 1986).

Within each of the three stages of the interview (see Appendix), a collection of questions that expressed a similar motif was included. Hence, it was expected that themes would arise in a natural order from these stages. In response to stage one questions pertaining to (focused life history), participants shared their life experiences in terms of relevance to their career path. For stage two questions (details of experiences), participants reconstructed their experiences in terms of relevance to climate and work-life

balance. For stage three questions (reflection on the meaning), participants reflected on their experiences and considered how their experiences shaped their lives.

While the three stages of questions (focused life history, details of experiences, and reflection on the meaning) helped to facilitate the story-telling experience for participants, through the natural course of interviewing, I asked probing questions to solicit responses that addressed the main research question.

Using Saldaña's (2009) a highly structured inventory for coding, I read the transcripts several times and went through two cycles of coding to identify emergent codes. After this iterative process, 33 useable first-order codes (compiled from in vivo and descriptive codes) were identified and determined to be mutually exclusive (see Table 6). The emergent codes were sorted for similarity and then grouped under six broad categories that expressed a general dimension relating back to the research question. These categories included: *barriers (work)*, *barriers (self)*, *safeguards*, *inspiration and motivation*, *coping mechanisms*, and *role identification* (see Table 6). The process then continued as I identified subthemes, grouping the subthemes into four major themes, which I characterize as key findings. I present the codes, categories, subthemes, and themes in order. This discussion is then followed with a presentation of the four themes, which I characterize as the four key findings (see Table 7).

Table 6.

Summary of Codes, Categories, and Subthemes

Codes	Categories	Subthemes
(1) Women rarely selected for leadership roles; (2) Women appointed to diversity committees; (3) Colleagues' messages about my work being unimportant; (4) Assertiveness seen as aggression; (5) Task-oriented vs time-oriented; (6) Feeling sense of isolation in being the only woman; (7) Colleagues downplay problems	Barriers (Work)	(1) Feeling under-valued is a self-fulfilling prophecy; (2) Gender stereotypes affect women's advancement; (3) Tokenism does a dis-service to women; (4) Unstructured work schedule and workplace climate
(8) Child-bearing and maternity leave affect tenure; (9) works against women; (10) Finding time for children, aging parents; (11) Spouse role in household; (12) Role reversal is inevitable; (13) Family is a priority	Barriers (Self)	(5) Biological time clock is a factor; (6) Work-life balance and work-life integration
(14) Backbone of successful career woman is family support; (15) Maintain personal and professional life; (16) Good work culture demonstrates getting along; (17) Finding a mentor and being a mentor	Safeguards	(7) Value of family support and friendships; (8) Mentoring reduces work stress
(18) Boost self-efficacy, improves credibility, visibility; (19) Professional development is important; (20) Team work improves creativity, increases innovation; (21) Collaborative projects have collective impact; (22) Being part of larger community lifts spirit, community; (23) What it means to be an engineer	Inspiration and Motivation	(9) Academic achievement and team projects boost confidence; (10) A sense of purpose
(24) Managing stress, tolerating stress when solutions not available; (25) Sacrificing interests; (26) Reducing friendships; (27) Being a good mother reduces "me" time	Coping Mechanisms	(11) Protection and self-preservation
(28) Seeing oneself as an engineer (separate identity); (29) Sense of purpose; (30) Seeing oneself as a mother (separate identity); (31) Children are my first commitment; (32) Seeing oneself as an engineer and mother (dual identity); (33) My children give my work a sense of purpose	Role Identification	(12) I am an engineering professor; (13) I am a mother; (14) I am an engineering professor and a mother

Before introducing the subthemes and then themes that emerged from the categories, I explain how the six categories emerged. In reviewing participants' thick rich descriptions

about specific barriers, I determined that there were two distinct types of barriers, those that were personal and psychological and those that were work-related. One such work-related barrier is the feeling of isolation (i.e., being the only woman in the department). The loneliness barrier was expressed by all participants as a persistent factor. In describing being one of only three women who completed her PhD under a prominent researcher, March expressed how important it was to have a renowned researcher as a mentor:

> I was his third woman, but the other two had already finished, so I was the only woman, and it was really important to have someone that well respected be your advisor because it credentialed you when you went out in the field where people of course assumed you were chopped liver.

From participants' responses, the most prominent example of the *barriers (self)* category was related to the biological time clock. June expressed a feeling of remorse:

> Biology works against you. By the time we were trying and went through tons of infertility treatments, then feeling that regret that I shouldn't have waited. So, I think it's definitely not good to send people these messages that you should wait until you have tenure. We need to tell women you can have a family when you feel ready.

In contrast to the category of *barriers*, the category of *safeguards* expresses those strategies that participants devised to maintain their sense of work-life balance, and in some cases, participants used the term *work-life integration*. The category of *inspiration and motivation* expressed participants 'ah-ha' moments that helped them move forward

with energy as they navigate their career trajectories. In a few cases, participants found that supporting their families became more important than applying for early tenure; and in these cases, the central theme of gender equality become secondary. June said, "My daughter is commitment number one. I limit time away from home for business travel but also setting boundaries, so in the evenings, it's her." While November said, "Being single mom of two boys, for me, it was all the time centered around the boys; and my career because that's [/the/] standard income source I would say for our family life."

Given the limited and fragmented work schedule in engineering academia, the category of *coping mechanisms* describes those spheres of activities and actions that participants take in order to manage stress and resolve conflict in the home and at work. September described how she coped with an untenable situation related to her child: "It was difficult, and there were plenty of meetings at work. On occasion, I would bring a sick kid into my office. Maybe even have them sit curled up at the back of the classroom." October expressed difficulty in negotiating time with her spouse and her son:

> Toughest on my relationship with my spouse because he is taking a back seat to my son, and then my son has taken a backseat to work this year. My thinking on that was just that this would require an initial higher time investment, and I discussed that with my spouse before accepting the job that these first few years would be more time.

The category of *role identification* referred to the different roles that participants held in various stages of their life. In taking on multiple roles, such as being an engineering

professor, a mother, and a care-giver, some participants reported feeling role strain or role overload. October expressed feeling a sense of obligation when she became a mother:

> So, I'd say becoming a mother has sort of changed my expectations of the world. It's not exactly 50/50 now with my husband. And as much as we would like for it to be, I still have to shoulder most of the childcare responsibilities, keeping track of all of the little things, you know, that mental burden that they talk about.

These six categories encapsulated common sentiments expressed by all participants.

Reviewing the categories against the conceptual framework of the study and conducting an analysis of the words—including the constant comparison method, word repetition, KWIC, and metaphors and analogies—I searched for patterns in the data. I drew inferences on the basis of the codes and categories, including my own memoing and journaling, to generate 14 subthemes (see Table 6): (1) feeling under-valued is a self-fulfilling prophecy; (2) gender stereotypes affect women's advancement; (3) tokenism does a dis-service to women; (4) unstructured work schedule and workplace climate; (5) biological time clock is a factor; (6) work-life balance and work-life integration; (7) value of family support and friendships; (8) mentoring reduces work stress; (9) academic achievement and team projects boost confidence; (10) a sense of purpose; (12); protection and self-preservation; (12) I am an engineering professor; (13) I am a mother; and (14) I am an engineering professor and a mother.

To provide a basis for my interpretation of the data, I include a selection of quotes from participants for each of the 14 subthemes. The selected quotes support the literature and connect to women's ways of knowing as a conceptual framework underpinning this

research. Not all subthemes directly related to the research question, though their emergence was important to the women's experiences. Finally, these subthemes led to the four themes or key findings related to the research question, which I will discuss following an articulation of the subthemes.

There were four subthemes related to the category of *barriers(work)*. They were: (1) feeling under-valued is a self-fulfilling prophecy, (2) gender stereotypes affect women's advancement, (3) tokenism does a dis-service to women, and (4) unstructured work schedule and workplace climate.

Subtheme 1: Feeling Undervalued is a Self-fulfilling Prophecy

In describing their individual experiences with navigating the tenure process, each participant manifested the concept of personal value in different ways. Some participants described observations of other women, with whom they relate, while other participants described personal experiences of feeling under-valued. March stated, "I certainly feel under-valued in terms of my FTE [full time equivalent] for the ADVANCE [special grant] position. I've also felt under-valued because I used to be called the Associate Dean of Academic Affairs, and that included the diversity piece." Similar to March's experience, May reflected on her feelings of disappointment upon receiving news that her early tenure was denied; she expressed feeling de-valued:

> Most recently, my colleagues approving tenure made me feel valued and then on the other hand, the chancellor denying it, made me feel devalued because he denied all early-tenure requests. I feel like he didn't look at our specific packages which made me feel like I was just another person in the crowd.

In response to the question about feeling devalued, September described social science research she conducted that involved analysis of over 100 videotaped interview sessions. In the analysis of her data, including when questions started and ended, September demonstrated that women were interrupted more than men. She described her personal experience of being interrupted:

> I think the feeling devalued happens occasionally at the sort of micro level. After I started doing that study on interruptions, I became very, very highly attuned to conversational interruptions. And so, when people would interrupt me, that bugged me. There were a few times that it happened when I was associate dean. There were these monthly meetings with all the department chairs, and the dean, associate dean, and I would say something, and I would get interrupted.

August shared a similar experience about feeling de-valued during meetings:

> There's the historic thing of being interrupted while you're talking in a meeting, right? So, there's a couple of faculty members that are particularly bad about that. So, you know, I've gotten to where I say, “As I was saying,” and just finish the comment.

In terms of feeling valued, October expressed said:

> You know, feeling like your ideas are heard. Or when they're heard, and then you're in a meeting, and you mentioned something to your colleagues, another colleague will not only agree with you but reiterate your point to everyone else,

> strengthens and amplifies the response that you gave. That's definitely validating to me.

Subtheme 2: Gender Stereotypes Affect Women's Advancement

All participants expressed some experience with gender stereotypes. The concept of *imposter syndrome* was mentioned by five participants, while the personal experience of gender discrimination was shared by seven participants. January, a single mother, shared her concerns about the current climate in her college but did not explicitly state it was due to gender inequity: "Sometimes I do hear things that I'm not very comfortable with. I don't want to say it's discrimination, but sometimes people may have some stereotypes in terms of how we perform in academia [academic] setting." By contrast, February rejects the idea of the 'woman engineer:'

> So, for me, being a woman in engineering is important in showing that anyone can be an engineer. I don't think that there's a stereotype of what a woman in engineering is like. I think an engineer is an engineer. But I do feel like I kind of carry a flag of "Hey, look at me, I can do this." And so that's always kind of a weight in the back of my mind.

September described her lack of self-confidence during her college years:

> I was quite insecure when I was in college and in grad school. I had a classic case of imposter syndrome and was very insecure about my work and thought I didn't belong, and I wasn't smart enough. It took a lot of years of being in this position for me to realize that I was actually doing a really good job. I've become much more confident, sure of myself, knowing I'm good at this, I'm happy with this, and

> I can accomplish a lot of things that I want to accomplish – which 20 years ago, I wasn't sure that I'd be able to accomplish anything. I didn't even think I'd be able to survive in the job.

October also expressed how the imposter syndrome affected her sense of confidence. She compared her worth as an engineer against her views about her colleagues' innate abilities:

> I didn't have a lot of confidence in myself as an engineer. I still don't, I guess I could say coming to college and everything, just feeling they talk about that imposter syndrome. I felt that other students whose dads were engineers, or they were the third in their family as engineers or brothers and sisters, they knew what they were doing.

December talked extensively about the imposter syndrome, lamenting that she herself experienced it during her graduate school days:

> When I first started learning about imposter syndrome, I definitely experienced it. In grad school, I started to experience it. "I'm not as good as my male colleagues, they're getting a lot of good projects, and I don't think I'm as good as them, I'm not going to make it, I wanted to quit." No one's told you that you're not good at this, and so I had to start telling myself to get out of that voice because I still feel [/alone/] sometimes.

Subtheme 3: Tokenism Does a Disservice to Women

In sharing their personal stories about being the *only one*, either in their department or in some cases, in their college, participants felt it was important for them

to dismiss any suggestion that they were hired to meet a diversity target. They described situations where their colleagues, including deans, associate deans, or department chairs, tasked them with a role that was stereotypical. In describing her relationship with her department chair, February stated that he is both supportive and disparaging at the same time:

> He wants me to be successful, and he's provided support; while the same time, asking me to host baby showers and be the social chair and things that are just kind of insulting. There's definitely good and bad with him. I know that he has children about my age. And so, he talks very candidly with me and is very honest, but at the same time, sometimes I wonder if he sees me as a true colleague or not.

January described tokenism as occurring after women faculty are granted tenure. She shared that women faculty were being relegated to various committee roles that were predominantly associated with diversity and inclusion work. She shared how tokenism affected women's progress toward promotion:

> Promotion to full professor, probably that's one of the biggest obstacles for women faculty because before tenure, your support network is bigger, and you are expected to get out in in six years. But now after tenure, you're being put into all kinds of committees, and then the protective network is not as strong; and then you have your family responsibilities.

Subtheme 4: Unstructured Work Schedule and Workplace Climate

October expressed the greatest level of enthusiasm for participating in this study. She was 8 months pregnant at the time she responded to this call for research participants.

She described trying to find a way to negotiate her child-care obligations against her work commitments. While she did not specifically state needing to stop the tenure clock, her narrative statement indicates the need for this option:

> Having a child really changed me. I didn't care about family before, but it really changes all of your priorities. You know, making sure to leave in the evenings on time so that you can get home in time to see your kids, not accepting weekend and evening commitments whenever possible for the same reason. My career is important to me. So just trying to balance that, figuring out how many of those evening commitments I can defer.

In commenting about the workplace climate, September shared that she was the first woman hired in her department. She shared that there were comments made about women's intellect but that such comments were not publicly manifest:

> When I when I first started here 23 years ago, there were about 40 faculty in the department. I was the fourth woman. And over the next few years, the other three women all left. For many years, I was the only woman in the department, and I wouldn't say that there was a lot of overt hostility or discrimination, there were tiny bits of it. There were occasional remarks people would make about women like someone saying, "I've never had a woman grad student in my group because I've never met a woman smart enough to be in my group."

Next, in the category of *barriers (self)*, I found subthemes (5) biological time clock is a factor and (6) work-life balance and work integration.

Subtheme 5: Biological Time Clock is a Factor

For women who delay family planning, the child-bearing experience can be upsetting. June described her trials and tribulations with use of fertility drugs and expressed a sense of regret in delaying her family planning: “Oh my gosh, I shouldn't have waited. Why did I think I could wait? Biology operates in a certain way.” October explained that the child-bearing years for women are different than they are for men. She described how she convinced her husband to concede to her family-planning time-line:

> I was pushing my husband to start trying to have a family even when we were in graduate school. We had trouble actually, so it took us a few years. I think in a lot of cases that is what's happening. The woman is pushing.

December shared her views about maternity leave and lasting effects on women’s bodies:

> Well, I think that we think a lot more about timing of when we’re actually going to have children because it does take you away. Even if they stop your tenure clock, it takes you out of the lab, it takes you out of the environment, it makes it more challenging to mentor your students. I think for me, compared to my husband, I think about that a lot more because it means that's a big change, and it affects my research, it affects my potential exposure. And it's exhausting. So then, we haven't talked about even the 9-month gestation. Women's bodies do change; so, there's a physiological change that we can't deny that happens to women who have children, and men talk about that a little bit.

Subtheme 6: Work-Life Balance and Work-Life Integration

January is a young mother, and her daughter is of toddler age. As a new mother, she described her new experiences in trying to juggle multiple commitments in a two-body problem; both she and her husband are both tenure-track professors:

> Right now, I think my family is probably the most important thing, and that's why I'm very interested in this study. Both me and my husband, we are tenured professors, and that makes it even more challenging. For example, this morning, I was trying to put my daughter, who is a toddler, into the carriage to daycare, and there were all kinds of drama.

In her attempt to determine whether there was equity in her household, August shared a humorous idiosyncrasy she had in her early years of marriage:

> So, the first year that my husband and I were married, I actually kept a list of hours that I spent doing household work and the hours that he spent to make sure that it was pretty balanced. By the end of the year, it was pretty balanced. So, I quit doing that. Since my daughter's been born, I think overall, he's really good.

Next, in the category of *safeguards*, I developed the subthemes of (7) value of family support and friendships and (8) mentoring reduces work stress.

Subtheme 7: Value of Family Support and Friendships

Participants described their home life, including the relationships with their spouses and their friends, and specifically, the type and level of support each relationship contributes. August lamented about her husband’s lack of skill regarding a simple household chore:

> There have been times when I've been frustrated about needing to ask him to do certain things. I've actually gone around the house and tried to show him how to pick up. There's a hundred things that need picking up, and he picks up two things. Here's this, it's not in its right place; so, we need to put it over here. He's a doctor, he should be able to figure out picking up, right? That should be simple. I've kind of given up just trying to get him to understand the pick-up thing.

December recounted a conversation she had with her female faculty colleagues, who had husbands who held antiquated stereotypical views of male-female social roles:

> I talked to some of them, and their husbands are more traditional. They expect her to clean and cook and take care of the children largely, and he'll do grilling and take care of the yard. I'm like, you can't live like that. You will burn out and die.

January was trying to negotiate having a second child; she stated that her husband is more helpful with household chores now because he is eager to have a second child:

> So, then he wants to have more kids, and I said, well you need to help because otherwise I'm not going to survive this, and he agreed. I still need to cook and everything, but he washes the dishes and takes care of the kid. I'm not complaining. So, when we were going through the first batch [/bunch/], he didn't do too much, but now he's doing much better.

February spoke dotingly about her husband's level of support for her and compared her relationship with her husband with that of her children:

> So, my husband would be the most important relationship. He and I met in high school, and we went to different colleges, and we got married right after

> undergraduate. He's been with me through grad school and the job search and all the way through tenure track; and he has been my biggest supporter. Relationship with my kids is very important but also very taxing. That's one that I try hard to prioritize and yet segment at the same time. But I don't have to segment my husband.

Aside from the support she receives from her husband, February described a group of women with whom she regularly meets and considers them as her friends:

> I have this this group of associate professor women faculty across campus, and we are kind of support group. And we started meeting about once a month a few years ago, and they're kind of like my crew. They're my there my sounding board, they're relief for me.

May shared a story involving her husband as her sole support system:

> A four-year old and a six-year old, getting them to and from school every day, and getting them fed… And my husband is very supportive, but there's still a fair amount to do. We're far enough away from other family members that we don't have additional support, and it's just the two of us unless someone comes to town to help out.

September stated that she relied on her mother to help with childcare whenever she was away at a conference: "For any conference, it always involved my mom. I would drop the toddlers off at her house in [redacted] or she would come to where I was." In addressing the issue of support for women, August expressed that it was important for men to share equitably in the affairs of the household. At the same time, it was valuable to

acknowledge women's work in the household as an important first step toward embracing women's contributions to family:

> I think part of it is getting spouses to do their part. Sharing the workload at home is really important. You know, it shouldn't be assumed that the female has to do all of it. It should be more of a 50/50, but even somebody that has a spouse doing 50/50 at home is going to do more at home than somebody who has a stay-at-home spouse taking care of everything. That's something that I really think is just totally not talked about ever; and it needs to be because people who are doing a lot more at home, their effort needs to be recognized.

Subtheme 8: Mentoring Reduces Work Stress

February described that she had a mentor who was instrumental in helping her alleviate some work stress she experienced due to the tenure process:

> I had the pleasure of working with the department chair, and he's a wonderful major professor as well. Now we are friends; he's my mentor. I'm actually very grateful for that experience, and I'm trying to do the same. The way he mentored me and the way he approached research and how he interacted with other students impacted me greatly. I sometimes call him.

March was an associate dean and has had over two decades of experience leading women advocacy programs. She promoted mentoring as a way to help women engineering faculty alleviate stress:

> One of the things that I made up—that we've cultivated that I think is really helpful—is the term ventor, which is like a mentor to whom you vent. And so, it's

> really important to have someone where you can forward an email and say, "Can you really believe what this asshole just wrote to me?"

In discussing the importance of providing an outlet for women, September described some challenges with trying to recruit and retain women and minorities. She described some of the resistance she observes at her institution as it relates to providing mentoring support and other activities to advance the prominence of women engineering faculty:

> You have a small group of people who are actively working to increase diversity. And then you have a small group of people who really think that that's a load of BS and we shouldn't be doing that. And then you have this large middle group that is just kind of uninformed and thinks there's no problem. They're certainly not actively hostile, but they're also not actively helping. I think that's maybe the situation at many places. Yes, there is a problem, and we need to try to do something.

For the next category, *inspiration and motivation*, I found subthemes (9) academic achievement and team projects boost confidence and (10) a sense of purpose.

Subtheme 9: Academic Achievement and Team Projects Boost Confidence

One participant, November, described having to submit her tenure denial for reconsideration by the university provost. The provost over-ruled the dean's decision and granted her tenure. November expressed apprehension about whether she will be granted full professorship, but at the same time, she also expressed resilience:

> Overruling the dean didn't make it easier afterwards. The first meeting with the dean was really hard because I didn't even know how to react. He didn't even

> want me there anymore, and he was so upset that I was still there. I have to be strong. You don't have shoulders that can support, you have to pull out your springs for your kids and say, "The show must go on." You have to have your smile on your face and keep going. There was no failure, not an option. Honestly, for me, and that was my driving force.

September described her feelings about being a role model for her students:

> When I'm up there in front of a class, I know that I'm a role model. I know that there's a certain amount of pressure on me. If some students have never had a woman engineering professor before then, if I screw up and say something stupid. then it's going to look bad on women generally. So, there's a sense of pressure that comes when you're part of a little minority. In research, I would expect even more. I've probably been receiving both advantages and disadvantages from my gender.

Subtheme 10: A Sense of Purpose

In navigating their academic pathways, participants revealed experiences that inspired a sense of purpose for them. Some of these experiences were personal while others experienced events vicariously, suggesting that they were duty-bound and felt a sense of obligation to support other women. Driven by her sense of passion for the work that she does, July described her teaching responsibilities in venerable terms: "I really love it. I really love it. I love teaching. I love being updated with new technology to actually developing the new technology and to understand it so well that you can actually explain it to others." March expressed a desire to help more women enter engineering

academia. She reminisced on an incident in her past when she experienced an unpleasant situation at work, which reinforced her sense of duty in implementing programs that support women engineering faculty through the tenure process:

> You know, if I could do it all again, I'd do it differently. But you know, back then there weren't programs like this, no understanding, so I tell people my first department chair would come to work wearing a tie with a Playboy bunny. And it was so gross, and nobody would notice, but he was also a very bad chair, too. So, yes, so we've come a long way.

June is energized by the prospect of being able to lend her experience to helping other women through the tenure process: "I think it's that idea that you could be a role model for other people, and that I do think I'm helping engineers to bring this philosophy into what it means to be an engineer, that's my value." June also attributed her sense of purpose to her daughter: "After I had my daughter, in all my classes I started integrating sustainability on purpose because now, look at the world out there and the world into which she's going to go." By contrast, December observed a situation that inspired her and gave her a sense of advocacy purpose:

> And then there was a really shocking event…The department made an offer to a woman after a decade of not making any offers to women. The woman had made it clear that she was intending to accept the offer if we made it. She declined the offer because she'd gotten an anonymous piece of hate email which said that she wasn't smart enough and she shouldn't come here. It was someone in the department who sent that. I reported it to the office for the prevention of

> harassment discrimination; they brought the police into it, and the IT guys tried to figure out who sent that email.

The next category of *coping mechanisms* included only one theme: (11) protection and self-preservation.

Subtheme 11: Protection and Self-Preservation

November, a single mother of two sons, expressed a poignant picture of the experience of separating from her husband to protect her two sons. She described feelings of inequity in her professional and home life and how she preserved her sense of self:

> They don't like you being a strong female and having a PhD, so they feel kind of threatened by this. And that was the case with the father of my boys. Unfortunately, why he finally stepped out; because it was not a healthy environment what I could longer hope for my boys. Clearly, they suffered. But since I saw changes in their behavior, I said, “That's not healthy anymore.” I needed to take action. That my boy, especially my older one, was screaming every night. That was one of the things that my partner could not accept, me growing in my job and my responsibilities and getting my PhD.

July described an incident that occurred at her university last year which left an indelible impression on her sense of fairness; she expressed a desire to protect others:

> Now last year, I think I did hear there was [sic] very public articles being written about how badly the [institution name redacted] is for women. If I had a daughter, I [/wouldn’t/] ever want her to work here. I will say she's not going there to be treated like that by these sexist pigs. And I tried to say something about that in the

> school; I want to protect women, but we cannot say it's a horrible place because they will [/put/] this curse on us.

In describing a formal approach to protecting women engineering faculty, March described a department policy that was institutionalized as part of the tenure process:

> In EE, we always make sure when there's a woman either coming up for promotion to associate professor or full professor, we always make sure there's one woman on her committee. We have enough women to do that. And I think that's really important because she can just be there as a support and make sure it doesn't go down the White male rabbit hole, which could happen. I've seen that, we've all seen that.

April talked about her threshold for maintaining her physical health and sense of self:

> I will say a big turning point for me was finding the right primary care physician because of the help front. The person I had originally was just like, "You know, try to find time to fit in a little bit of exercise 10 or 15 minutes a day." I can't do this. I'm tired. I'm exhausted. I'm sleep-deprived. I've got more things to do with work than I possibly can find time, and so exercise is not happening for me. This is what you need to do diet-wise to help get yourself to a better place healthwise. I sleep a lot better. I think that's been a huge part of getting my health back on track.

For the final category, *role identification*, I found three subthemes: (12) I am an engineering professor, (13) I am a mother, and (14) I am an engineering professor and a mother.

Subtheme 12: I Am an Engineering Professor

When asked about what role she most identified with, April embraced her engineer identity, expressed no significance for being a woman engineer, and stated that the two roles were disconnected:

> So, this is kind of an interesting contrast to being a woman in engineering. I would say in a lot of ways, it's flipped now, identifying more strongly as being a woman. If you would ask me as an undergraduate, I was kind of like, "Well, yeah, I'm a woman and I'm an engineer." But being a woman in engineering wasn't really a big deal to me. I didn't join SWE, Society of Women Engineers, when I was an undergraduate.

Likewise, December shared a similar perspective about what it means to be an engineer:

> I think it's a struggle between confidence and coming across as overbearing. I think it's a struggle between how you present yourself in public and how that comes across to people, whether they see it as strength or whether they see it as domination, domineering. I think it can be a struggle; and a lot of these fields where traditionally they're seen as more masculine fields.

Subtheme 13: I Am a Mother

April shared her experience with being mother to her young son and having to handle the effects of her absence from her children:

> It's only been very recently that my son goes to bed and sleeps well enough that I could conceivably do some work after he goes to bed. I go home at 5:00 and spend time with my family. The kids go to bed at 7 or 8 o'clock, and then I got a

> couple hours to do work before bed. I would go away on a business trip, and then he's super mommy-clingy when I get back, and I've been gone for a week.

July declared that her son is the most important aspect of her life, and that being a good mother was first and foremost, even though she gains contentment in being an engineer. July said, "The most important thing, with all honesty, for sure my son. Even my grandmother was very insistent on be yourself. I was the first woman in the family to actually get a job."

Subtheme 14: I Am an Engineering Professor and a Mother

Having reflected on negotiating the dual role of engineer and mother, June provides advice to young women faculty when selecting an institution to work at. She encourages women to find the right fit and recognize that climate is an important factor:

> If you feel too conflicted with where you are, your institution or department climate, then don't throw out the professoriate as a whole. But you may need to think hard about can you find a better fit, somewhere where your value system and what you can give is accepted.

August has one child, a daughter whom she is encouraging to pursue a career in engineering She shared her aspirations for her daughter's future:

> In terms of personal life, my daughter, my goals for her are to be a kind person, to make a difference in terms of helping people through her career. And I think engineering is a great way to help people, but if she wants to do it some other way, that's great too. And then to have a faith dimension to her life. So those are

my kind of three main goals, and if she has those things at the end, I'll say that I've been successful.

Four Themes or Key Findings

In analyzing the 14 subthemes in terms of the research question, theory, and empirical research, patterns emerged among the participants' descriptions of their experiences. Four themes, which I characterize as key findings, surfaced:

- Participants experienced gender stereotyping in engineering academia;
- Participants recognized overlap between the tenure and biological clocks;
- Participants expressed a default arrangement in assuming the burden of childcare;
- Participants revealed that work-life balance is a false concept.

Table 7 shows the connection between the 14 subthemes and the four themes or key findings. The subthemes are enumerated according to their initial ordering based on Table 6. I elaborate on each of the four themes or key findings following Table 7.

Table 7.

Connection Between Key Findings (Themes) and Subthemes

Key Findings (Themes)	Subthemes
Participants experienced gender stereotyping in engineering academia	(1) Feeling under-valued is a self-fulfilling prophecy; (2) Gender stereotypes affect women's advancement; (3) Tokenism does a dis-service to women
Participants recognized overlap between tenure and biological clocks	(4) Unstructured work schedule and workplace climate; (5) Biological time clock is a factor; (8) Mentoring reduces work stress
Participants expressed a default arrangement in assuming the burden of childcare	(7) Value of family support and friendships; (9) Academic achievement and team projects boost confidence; (11) Protection and self-preservation
Participants revealed that work-life balance is a false concept	(6) Work-life balance and work-life integration; (10) A sense of purpose; (12) I am an engineering professor; (13) I am a mother; (14) I am an engineering professor and a mother

Participants Experienced Gender Stereotyping in Engineering Academia

The first key finding emerged from the following subthemes: (1) feeling under-valued is a self-fulfilling prophecy, (2) gender stereotypes affect women's advancement, and (3) tokenism does a dis-service to women. Participants talked about gender stereotyping in engineering academia and described feelings of being under-valued in the context of addressing implicit and explicit bias (Gladwell, 2009; Steele, 1997), both during graduate school and in the workplace. While participants' career trajectories revealed similar experiences during the undergraduate years—specifically, being immersed in the exploration of engineering—it was during the graduate school years that participants encountered any level of inequity. Participants also described stereotypical language used

by male peers and tokenism enacted by department heads. They identified stereotypes and tokenism as challenges that women professors must overcome in engineering academia. January and July were employed at R1 institutions while November was employed at an M1 institution. January and July spoke cautiously about the current climate of their institutions, while November spoke vehemently about a negative experience she had with the engineering dean.

With respect to gender inequities—specifically on the theme of how gender stereotypes affect women's advancement—only one participant, November, used the term "discrimination." November provided a detailed narrative of how the university provost intervened on her behalf and granted her tenure after her dean denied her tenure. From the perspective provided by most participants, the inequities described appeared to be at the micro-aggression level, with only three participants describing overt acts of aggression by male colleagues.

Participants Recognized Overlap Between the Tenure and Biological Clocks

The basic premise that women engineering faculty with children were unable to attain tenure because of the biological clock was explored in depth by all participants. This key finding included the subthemes of (4) unstructured work schedule and workplace climate, (5) biological time clock is a factor, and (8) mentoring reduces work stress. Nine participants described having felt pressure during their undergraduate years about role conflict, specifically how a career in engineering will impact their desire to have children. In describing their experience of the child-bearing years, participants recounted how work was delayed, including stopping the tenure clock, how

responsibilities for parenting were deferred to another member of the family, and how they benefited from mentoring which helped relieve work stress. Comments from participants shed light on their understanding of decisions related to their career trajectories and how they used coping mechanisms to negotiate the social expectations of being both a mother and an engineer.

Participants Expressed a Default Arrangement in Assuming the Burden of Childcare

Despite family support and friendships that enabled participants to adapt and accommodate work commitments, most participants assumed the burden of childcare. This key finding emerged from the subthemes of (7) value of family support and friendships, (9) academic achievement and team projects boost confidence, (11) protection and self-preservation. With the exception of July and November who were divorced single mothers, participants had family members who accepted their work life and understood how their career would impinge upon time with family. Some participants viewed working past normal business hours as positive because they were able to integrate work into family life, while others believed a reprieve from work was necessary to focus on family.

Participants' passion for their career was fueled by academic achievement and team projects. To fulfill their sense of passion, participants stated that they appreciate having more support for childcare, either from spouses or parents. They believed that family support was a contributory factor in their career success. Where family support was absent or limited, participants mastered protection and self-preservation skills to

manage childcare and career. Their comments arose from a recognition that engineering academia is male-dominated, not just in terms of the numerical representation of men but also the unstructured work schedule, arguably that which was created by men for men. Historically, engineering academia is linked to a workplace climate that has operated to the advantage of those who have no family responsibilities.

Participants Revealed That Work-life Balance is a False Concept

The final key finding emerged from four of the subthemes: (6) work-life balance and work-life integration, (10) a sense of purpose, (12) I am an engineering professor, (13) I am a mother; (14) I am an engineering professor and a mother. Participants described how they negotiated perturbations of family life to accommodate the tenure process. They grappled with managing multiple identities—of being an engineering professor, of being a mother, and the duality of being both simultaneously. Recurring notions that permeated throughout their responses included how gender may have played a role in their shared experiences, how women were professionally disadvantaged as compared to men, and how women were compelled balance their family and work lives. Few participants used the term "balance," and all participants described planning family duties around work life. This suggests that they may have contemplated work-life integration as opposed to work-life balance.

Participants' responses supported the view that women engineering faculty with children experienced more hurdles in achieving tenure than women in other fields because engineering is an application-based discipline. Owing to the fact that engineering academia generally promotes a research component—with tenure-track faculty at R1

institutions devoting 60%–80% time on research (Jenkins & Solar-Lezama, 2018, slide 7)—faculty must be physically present in the laboratory to conduct research. This was evident in participants' statements as they described trying to complete their work before going home; it was not work they could do in a telecommuting format. The revelation that work-life balance is a false concept was acknowledged by all participants as they determined that it was work-life integration they were hoping to achieve.

Summary

In Chapter 4, I addressed the research question and presented the results from the interviews of 12 participants. Participants responded to five general interview questions and eight main questions (see Appendix). Participants shared a considerable amount of details about their personal and professional lives. From the analysis of the transcript data, a total of 14 subthemes and four themes which I characterized as the key findings emerged. The theme-generating process involved multiple readings of the transcripts to identify words and phrases that evoke a meaning.

This chapter presented an account of the data, data collection, analysis, and results derived from the experiences of 12 women engineering professors who have children. In Chapter 5, I will present an interpretation of the findings in the context of the conceptual framework and describe the ways in which the findings confirm, disconfirm, or extend the knowledge found in the empirical research and literature.

Chapter 5: Discussion, Conclusions, and Recommendations

In this basic qualitative study, I examined the work-life balance experiences of tenured and tenure-track women engineering professors who have children. The research question was, What are the experiences of tenured and tenure-track women engineering professors regarding family formation, child-raising, and the tenure process? This study's purpose was to provide an understanding of participants' experiences of work-life balance as a fundamental structure in their lives. I interviewed 12 women engineering professors (five assistant professors, two associate professors, and five full professors) using a modified interview protocol based on Seidman's (2006) three-stage progressive interview technique. This blended format incorporated an in-depth interviewing model by combining three separate interviews into one interview, allowing participants to share, reflect, and offer meaning to their experiences. During the course of interviewing, I asked probing questions to draw out participants' perspectives on work-life balance. In closing the interview, I asked participants for recommendations on how to support women engineering professors. They responded in one of two ways: by expressing a sense of duty in serving as a mentor to other women and by volunteering to be a participant for future research involving work-life balance. Their responses indicated that they had a vested interest in this study.

Analysis of data led to the identification of 14 interpretive subthemes and four key findings. The four key findings were

- participants experienced gender stereotyping in engineering academia,
- participants recognized overlap between the tenure and biological clocks,

- participants expressed a default arrangement in assuming the burden of childcare, and
- participants revealed that work-life balance is a false concept.

These findings are illustrated in the conceptual framework of this study—in Erikson's (1950) theory of identity formation, Gilligan's (1982) feminine ethic of care, Belenky et al.'s (1986) concepts of procedural knowledge (connected and separate), and Bandura's (1977) theory of social learning—and interspersed with findings in empirical literature.

Interpretation of the Findings

In this section, I provide interpretations of key findings in the context of the conceptual framework, noting how the findings confirm, disconfirm, or extend the body of knowledge found in the current empirical literature. To attribute meaning to the subthemes, I drew from the conceptual framework and the perspectives of theorists whose work informed my research. Participants' views about role identity—in reference to the duality of the role of engineering professor and the role of mother—is supported by Erikson's (1950) identity formation theory. I used Gilligan's (1982) feminine ethic of care to interpret participants' predisposition towards responsibilities to be nurturing and caring. When asked about whether they believed gender had an effect on certain aspects of their career aspirations or current work experiences, participants offered a variety of responses that drew upon Gilligan's feminine ethic of care. They declared that their children were the most important aspect of their life, and that it was their obligation to ensure the health and success of their children. In expressing a sense of obligation for

their children, participants spoke in the maternal voice, and their statements reflected Gilligan's feminine ethic of care.

In analyzing participants' reflections of their own identity formation and intellectual development, I examined participants' statements in the context of women's ways of knowing (Belenky et al., 1986), specifically attending to procedural knowledge. Although I found the element of separate knowing to be strongest among most of the participants—such that participants described adversarial tendencies when confronted by inequitable treatment and propensity for critical discourse—I heard the voice of connected knowing in terms of participants for whom empathy was a major source of learning. I heard this voice of empathy in one of two ways: in terms of participants' desire to support their students and other women colleagues and, to a lesser extent, in terms of how participants sought to understand others (e.g., by trying to rationalize workplace inequity).

In examining participants' perspectives on the significance of academic achievement and team projects in boosting confidence, I found Bandura's (1977) social learning theory to be reinforced in relationship to his tenet that people learn through observation and modeling. In this context, participants described the importance that mentors had in their academic advancement. I found that for the most part participants rejected the notion of work-life balance altogether. During Stage 3 of the interview—when participants were asked to reflect on the meaning of their experiences, including how they saw themselves in the role of mother and the role of engineering professor—they shared thoughts about role duality. For some participants, the roles were separate but

sometimes overlapped. Participants indicated that there was not enough time in a day to be able to fulfill responsibilities of both the mother role and the engineering professor role. For instance, participant May shared that limits on her personal time affected her academic life: “I realize there’s not time to do everything, so I’ve got to make choices.”

Identity Formation Theory

Progressing through the three stages of the interview, participants gradually took stock of their experiences. Linking past experiences to recent conversations with other women, they expressed a sense of elation whenever they were able to share their experiences as a means of helping other women. In examining how participants viewed the intersection of multiple identities—the identity of being a mother, being an engineering professor, and the dual identity of being both a mother and an engineering professor at the same time—Erikson’s (1950) identity formation theory was useful in clarifying how identities coalesced, as well as the concept of self or ego identity (Erikson et al., 1959), which refers to the aspect of a person’s being that is developed and perpetually changing through daily human interaction and new experiences.

Participants expressed being preoccupied with trying to contain the needs of children into the identity of being a mother. They described work in terms of that which was independent from family; work was considered a discrete part of life, and the identity of being an engineering professor was disconnected from the identity of being a mother. The idea of incorporating time with children into work time was explored by participants after all other attempts at balancing schedules proved ineffective. Participants expressed that time spent with their children and family gave them the most contentment; to

preserve this feeling, they set clear boundaries for home life and work life. This finding was consistent with the results of Rhoads and Rhoads's (2012) study, in which the researchers examined female professors' expression of the multiple identities of mother, professor, and researcher. The study results indicated that female professors with children did not want to be alleviated from their family obligations, and that doing so meant they were relinquishing a part of their identity as mother.

Participants also described succumbing to the stressors that arose from feelings of inadequacy regarding fulfilling the mother role responsibilities. At the same time, they expressed disappointment in not having enough time to fully attend to requirements associated with the engineering professor role. They wanted to do it all and discovered that they could not. August described what she felt was inequity in the social expectations of the working woman's role in the home. She described coming to grips with expectations of motherhood and suggested that child care obligations were defrayed for men who had traditional wives:

> I had no idea how much effort, in terms of the time, was going to be required in raising a child, just absolutely no idea. If I work 60 hours on my job, and I work 40 hours at home, that's a hundred hours a week. Then somebody who has all this support at home, maybe they work 70 hours on their job and 10 hours at home, which is 80 hours total. So, they're working 10 hours more on their job.

Participants also expressed trying to incorporate some of the mother tasks into some of the engineering professor tasks; it was an ideal that was reflected thematically in their

final reflections. This blended mother-engineering professor, evoking the notion of work-life integration, is reflected in August's opening statement:

> I was interested in participating in this study because I think it's something that's front and center in my life every day, all the time trying to do a good job at work. And then at the same time do a good job with raising my daughter and trying to make sure that I'm at least getting important things done in both of those areas.

August's statement reflects Erikson's (1968) concept of identity formation as it relates to how life priorities affect value priorities, specifically in the context of occupational identity; she was clear in affirming that she wanted to succeed in the role of the mother but also did not want to forfeit her obligations as an engineering professor. These comments seem to provide evidence that shifting priorities influence participants' role identity.

As participants described their evolution in the role of the mother, and having to grapple with creative ways to increase or maintain commitment to family, some talked about how improved relationships with their children strengthened their resolve to be successful in the role of the engineering professor. This discussion point suggests that participants felt accomplishment in the role of the mother and were then able to devote more time to the role of the engineering professor. Role identification was a dynamic process for participants as they negotiated a path toward tenure and promotion while trying to fulfill their own expectations of being a mother. Four subthemes (a sense of purpose, I am an engineering professor, I am a mother, and I am an engineering professor and a mother) emerged from participants' responses about their personal and professional

identities and where and how each intersected. The relationship between being a mother and an engineering professor was inferred for some participants in terms of a sense of purpose. June, trained as a civil engineer, included the topic of sustainability in her instruction because she wanted to leave the world a better place; this was part of her sense of purpose. She described incorporating ethics into her instruction after her daughter was born: “Look at the world out there and the world into which she's going to go. I think we need to be doing more in terms of sustainability in particular; so, that became really important to me.” June’s statement was also a time-ordered event; she adjusted her instructional content after her daughter was born. Herein, the identity of mother co-mingled with that of engineering professor.

Through introspection, participants discovered that they needed to somehow blend the time expectations of the mother role into that of the engineering professor role to be able to continue on an upward path toward tenure and promotion. In their closing statements, they shared that success in engineering academia had more to do with work-life integration; it was about fitting their family into their work life. Herein, the theme of *work-life balance and work-life integration* was dominant.

Several studies called into question the harmful effects of assuming too many roles. Mason et al.’s (2013) survey of faculty revealed that marriage and children were the main barriers to women pursuing science academia, and that role strain affected women to a greater extent than men. This study’s findings can be viewed along those of Tate and Lin’s (2005) study, which revealed that women of color persisted in engineering because they were able to develop multiple identities to adapt to various environments, as

opposed to having to balance or integrate those identities. Tate and Lin's sample involved students, while this study's participants involved professors.

Feminine Ethic of Care

Gilligan's (1982) theory of the feminine ethic of care assumed that women were socialized from the time of childhood to experience the needs and feelings of others; it emphasized that for women, human relationships evolved from a sense of caring. To explore whether gender-specific adaptation had any bearing on the home lives of participants, they were asked to share details about their commitments outside of engineering academia, including how they balanced and shared family obligations with spouses. Nine participants said they assumed the burden of childcare; and one participant, February, said her spouse was responsible for the greater share of household chores. February described how her spouse's support allowed her to focus on her academic work: "He is supportive not only emotionally, but the way our household runs is because he is a stay-at-home dad. And so, my career, in terms of what happens outside of our house, my career takes priority."

Two participants (July and November) were divorced single mothers; and so, the question about how childcare and household responsibilities were shared was modified to inquire about how they balanced time for their children. July stated that she and her ex-husband are "still very close friends," and that her ex-husband helps take care of their son: "And then the days that I teach, he's taking over, and now he's actually helpful." November, who was raised by a single mother, described the poignancy of leaving an unhealthy relationship; she expressed a sense of sorrow about her divorce: "My dream

world was that I make it better than my mom, and unfortunately, it did not happen." She expressed feeling fortunate that her two sons attended a school and an after-school program located near her university: "I thank God, at the beginning they went to [school name redacted]; and they are at the recreation center across the street." She relied on a neighbor's help: "One neighbor who helped actually to drive them to sports."

Although some participants described themselves as exhibiting stereotypically masculine behaviors—and used terms such as "tom-boy" and phrases such as "fix things," "playing with legos"—July and November were distinct in expressing a strong desire to be less reliant on men, perhaps owing to the fact that they are divorced. It is also possible that their responses were influenced by the fact that they were born and raised in foreign countries that have a patrilineal orientation. July opined, "I think women [/should/] be more practical. I shouldn't generalize. I am very practical." November, who started a motorcycle club for girls during her teen-age years said, "I wasn't as confident to wear skirts and stuff like that. We learned how to switch tires and stuff like that." The activities described by July and November are considered stereotypically masculine in behavior. In terms of the preconceived social values seen in gendered objects—such that "playing with legos" is different than playing with dolls—these behaviors contradict Gilligan's (1982) belief that women focused on relationships, and that this ethical perspective retains a feminine association. These socialized masculine behaviors are linked to Cimpian, Meyer, and Freeland's (2015) hypothesis that women are under-represented in fields such as engineering because of *field-specific ability beliefs*, or

beliefs in which people conform to a stereotype about their own community; and in this case, “playing with legos” is associated with maleness.

On the quality of spousal support for childcare, several participants held the view that men were less adept in carrying out childcare tasks, and that women generally assumed the burden of childcare responsibilities. January opined on men’s less-than-effective planning skills:

> I need to plan well because otherwise it's going to be very messy. My husband, he's wonderful, but he's not a good planner. You have to tell him, and maybe that's for every husband, exactly when to do what.

October expressed a similar view: “I would say women tend to be better at multitasking. Men tend to be better at focusing on one particular task.” June believed there was a fundamental difference between male and female engineering professors’ view of society: “But overall, most women, I think maybe care more about the broader context about society than just the technical details.” May described how motherhood changed her outlook and shared that duties were not equally shared with her spouse:

> So, I'd say becoming a mother, it's changed my expectations of the world. It's not exactly 50/50 now with my husband. And as much as we would like for it to be, and so I guess just keeping in mind that despite doing my job, I still have to shoulder most of the childcare responsibilities.

These statements supported Gilligan’s (1982) perspective that men and women may follow different paths of morality, contemplating rights and responsibilities when faced with moral challenges. Gilligan believed that men think in terms of rules and justice and

women think in terms of caring and relationships; so, for women, the care of children is natural: “While women thus try to change the rules in order to preserve relationships, men, in abiding by these rules, depict relationships as easily replaced (p. 44).” Gilligan contended that women were more willing to sacrifice themselves for their children.

The feelings of remorse for not being physically and emotionally present for their children and family, specifically having to forfeit time for work, was a common thread that ran through participants’ responses to the question about work-life balance. May alluded to a sense of self-reproach in describing her issue with scheduling time for family: “My husband is a veterinarian, so life is a constant scheduling battle and trying to figure out who's going to be where when. And so, I kind of feel like I don't do a very good job at anything.” In response to probing questions about the distribution of childcare tasks, repetitions of the terms “sacrifice” and “care” and metaphors for “being a good mother” and “reducing ‘me’ time” were prevalent throughout participants’ statements. Two subthemes, *protection and self-preservation* and *I am a mother*, emerged from these statements. In expressing a default arrangement in assuming the burden of childcare, participants spoke in the maternal voice, and their statements reflected Gilligan’s (1982) theory of the feminine ethic of care.

Participants determined that the organizational structure and tenure process were not adaptable to requests for modified work schedules. Compelled to complete the requirements of teaching, research, and service, some participants admitted to disregarding university policy regarding children in the work place. September admitted bringing her child to work: “You know things absolutely could not be canceled like a

class. Then I have brought a sick kid into work." November, a single mother, described having to consciously focus on her children even as she tried to engage in her research.

When asked about whether efforts to balance work and home life had an effect on maintaining their physical and mental health, participants recognized the importance of how they prioritized aspects of family and work for their well-being. For January, spousal support allowed her to relax: "I'm grateful that for those times I can leave the kids to my husband, and then I can take a deep breath and then maybe go and take a walk in the park." December stated: "You have to decide what your priorities are, and what things you're doing; and it forces you to be good at prioritizing what you care about and what you want to work on." February described experiencing panic attacks for 2 ½ years:

> I went and sought out a [/trained/] psychiatrist and some anxiety management. And I think it boils down to just trying to please everyone all the time. Having people I was trying to please at work and people at home and feeling always short-changing one or the other.

September shared that her experience with negative situations had a positive effect on her: "I think that a lot of these things have made me stronger and more resilient. I think it's actually for the most part had a really positive influence on my physical and mental health." May said, "There's one piece of advice that one of my female colleagues gave me which was you know, you have to find your good enough."

When participants were asked about whether they believed gender played a role in their career and how gender may have affected their early career aspirations, immediate responses were associated with the biological time clock. The theme, *biological time*

clock is a factor, was deemed by all participants as a barrier to tenure; they recognized that the end of the child-bearing years coincided with the beginning of the tenure clock. They maintained that the biology of the woman compels them to choose between two competing forces, the desire to start a family and the desire to have a career. Participants pointed out that women in engineering academia may be more disadvantaged than women in non-STEM fields because of the requirement of laboratory research, which typically exceeds the standard 40-hour work week. Participants expressed that the reproductive window—being narrower for women than for men—and child birth belonged solely to women. June questioned her decision to delay family planning: "Why did I think I could wait? Biology operates in a certain way." October described having to convince her husband to start a family: "I was pushing my husband to start trying to have a family even when we were in graduate school." December mentioned that child birth affected professors' access to laboratory research: "Even if they stop your tenure clock, it takes you out of the lab, it takes you out of the environment." These statements regarding women's biology and commitment to others reinforced Gilligan's (1982) feminine ethic of care, which is based on an orientation where "care" becomes naturalized as a feminine identity. Gilligan found that men's development is characterized by increasing autonomy while women's development involves enduring efforts to balance responsibility for others and preservation of oneself.

Several recent studies involving the biological time clock are supported by the findings from this study: Hart's (2016) study of mid-career women revealed that the timing of tenure decisions coincided with the peak child-bearing years; Eagly and Carli's

(2009) study showed that women in senior leadership roles tended to be single and without children; and Rhoads and Rhoads's (2012) survey of both male and female assistant professors revealed that because the burden of childcare was assumed by women, the likelihood of women gaining tenure was diminished. The studies of Gardner and Veliz (2014) and Gardner and Blackstone (2013) showed that women academics who have children achieved tenure and promotion at a slower rate than those without children.

Women's Ways of Knowing

Of the five epistemological perspectives of women's ways of knowing (Belenky et al., 1986), *procedural knowledge* (*connected* and *separate*) was expected to be the position most relevant to this study. In connected knowing, participants expressed empathy and sought to gain knowledge through empathy; and in separate knowing, participants wanted to be convinced. Although separate knowing and connected knowing are not gender-specific, Belenky et al. claimed women are more inclined to speak in the voice of connected knowing. In this study—where the participants were women professors in the male-dominated field of engineering—the mode of separate knowing resonated more often than did connected knowing. I detected patterns in their responses that included analyses of situations, a penchant for argument and debate, and a desire for critical discourse as well as a rejection of the social expectations for gender. This suggests that participants derived knowledge based mostly on separate knowing.

Among the responses from participants, there were several thematic illustrations of *connected knowing* that I could discern. In a desire to help others, March indicated that whenever a woman is up for promotion, her department ensures that there is always

another woman on the committee to provide support. Because March has experienced and observed inequitable treatment of women faculty during tenure and promotion decisions, she was able to empathize. Similarly, participants who recognized and embraced their role as mentors to their own students also spoke from an empathetic voice. Both March and September's professional roles involve providing mentoring to other women faculty, while June and July expressed feeling contentment in being a role model for their own students. This aspiration for helping others reinforced Fox's (2011) belief that women professors have a meaningful role in the success of other women.

Another example of *connected knowing* was heard as a general consensus among participants in describing how they may have short-changed their family in terms of having to choose between work and home life. Participants described having to overcompensate for what they felt was their absence in the role of the mother. In this instance, they avoided arguing or trying to convince others to help them; they did not want to risk the dissolution of relationships with spouses, family members, and friends to whom they relied on for support. They used phrases that alluded to 'going along to get along,' and they saw family as the backbone of their success. Family support was fundamental to their success in the work place. Their sentiments contradicted the findings from D'Enbeauet al.'s (2015) study, which revealed that family support or family flexibility did not attenuate the effect of work-family conflict. However, the study sample was comprised of women from the Middle East, North Africa, and India; and it is assumed that there are fundamental cultural differences in the perceptions of family obligations.

In trying to understand the opinions of others, I heard the voice of *connected knowing*, albeit to a lesser extent, when February spoke tenderly about her department head. While recounting a time when her department head asked her to host a baby shower, February characterized him as someone who wanted her to succeed; but she was skeptical about whether he considered her a "true colleague." In trying to gain understanding and rationalize her predicament through empathy, February justified his behavior by stating that he has children who are her age, and that he saw her as his own daughter. She expressed being conflicted in her feelings about him; she saw him as both paternalistic and patronizing.

The theme, *value of family support and friendships*, emerged from participants' statements about guilt. With the exception of February, whose spouse was a stay-at-home dad, and July and November, who were divorced single mothers, participants' spouses also worked full-time. Despite this, participants assumed the burden of childcare; they felt compelled to overcompensate. The voice of *connected knowing* bound them to empathize with their spouses' limits on time; but at the same time, this voice shifted them away from judging whether their time was equally valuable. Where children were involved, the voice of *separate knowing* seemed to be absent in that participants did not apply critical discourse to determine that they should not overcompensate for their spouses' lack of support; participants took on the burden of childcare. The lens through which participants' obligations to childcare was attached to the role of the mother was one that was caring and empathetic. This orientation of care and inclination for responsibility to others (Gilligan, 1982) coalesced with the voice of *connected knowing*.

Among the 12 participants, six participants (February, March, June, August, September, and November) strongly exhibited the mode of separate knowing. These six participants were employed at their respective institutions for 10 or more years. Their years of service and tenure rank may have fostered a toughness that was not observed in the other six participants, who are mostly assistant professors. February described herself as being forthright: "So I am very outspoken. So, I will go talk to people and say things." November, the only participant who grew up in a single-parent family, described having "tom-boy" tendencies and being influenced by her older brother:

> So, he always had to fix my mom's car. And as I was a little girl, I always tried to look over his shoulder, and he said, "You are a girl, go away." But the more he pushed me away, the more [/I/] was actually willing to get into it. I kind of worked my way up [/to earn/] his respect, to give him the tools. So, when he was laying under the car, and he told me, "Hey, give me this or give me that," he figured out sooner or later that I was pretty handy to be around.

In reflecting on the double standard for women who exhibited the stereotyped behavior of masculine strength and aggression, August stated that she was seen as aggressive:

> If you do the work and get things done, then you're seen as overly aggressive, right? But then if you're nice to people, then people think you can't get things done, right? Looking back, it seemed like a perfect instance of this "Hey, I got something done," but I wasn't collegial.

August did not voice any concern about being labeled "un-collegial." Being the sole female in her department for many years, she was exceptionally isolated: "We had our

50-year anniversary after I was hired on; so, I was only the second female to be hired, period." Belenky et al. (1986) stated that "it was dangerous for the relatively powerless to rip into the interpretations of the powerful" (p. 106). August's statement reflected the theme of *gender stereotypes affect women's advancement*. Her statements reflected Steele's (1997) work on stereotype threat and Gladwell's (2009) study on implicit bias, revealing our tendency to associate leadership with imposing physical stature. August's representation of a 'can-do-it' attitude is not an expected behavior for women.

Of numerous examples of *separate knowing* shared by participants, being selected to serve on committees, especially those that focused on a protected category was a common experience among participants. Although participants expressed a sense of obligation to serve, they did so begrudgingly; they believed that their service was perfunctory. They saw their role on cultural affinity committees as serving no purpose other than to give the impression that their department valued gender inclusivity. They expressed needing to be convinced that women were not being used as tokens; and their doubts projected the voice of separate knowing. The theme of *tokenism does a dis-service to women* was found in many responses. January lamented on the fact that service on committees affected women's progress: "You're put into all kinds of committee, and then [/your/] protective network is not as strong." June described committee participation as the "thankless task of doing service."

Seen as trail blazers by the junior women, March, an associate dean, and September, a former associate dean, said they felt duty-bound to help other women. Their desire to help extends Fox's (2011) assertion that women professors play a significant

role in increasing the academic success and retention of women engineering students through mentoring. While Fox (2011) regarded the mentoring of students, it was March and September's intention to mentor women faculty. In light of the fact that March and September's career trajectories disrupted conventional feminine stereotypes in the field of engineering, their eagerness to support their female colleagues was not unexpected. March was one of only three women who completed her PhD under a prominent male researcher; and September was the first woman to be hired in her department. March described misguided attempts by department heads who did little to support women but only gave the appearance of equality. These observations led her to be suspicious. The voice of separate knowing is heard in March's statements. In her position, she is tasked with supporting women faculty during tenure review; she stated bluntly that such support was "to make sure it doesn't go down the White male rabbit hole…I've seen that, we've all seen that." March's reference to "White male rabbit hole" referred to male bias, confirming two studies that showed gender bias was more prominent among male faculty (Handley et al., 2016; Moss-Racusin et al., 2012). The department policy described by March is acknowledgement that there is bias among decision makers. It supports findings from Ceci and Williams's (2015) survey that revealed sex bias in hiring decisions.

The theme, *feeling under-valued is a self-fulfilling prophecy*, emerged from descriptors shared by participants in response to the question about feeling valued or devalued. September, who currently holds the role of faculty equity advisor, said that negative experiences led her to become apprehensive but also motivated her to help women become less vulnerable. In comparing her own experiences against observations

of female colleagues, she described common barriers to women's advancement, including feeling a sense of isolation, being seen as aggressive, and being interrupted. She talked extensively about a study she conducted that demonstrated women were interrupted at a disproportionately higher rate than men during "academic job talks." She said that such interruptions can make women feel devalued. The linguistic connector in September's description is one of provenance in that she considered interruption a source of resentment for women. She expressed feeling annoyed: "And so, when people would interrupt me, that bugged me." Her statements supported the findings from the study conducted by Miyake et al. (2010), which utilized *values affirmation*, a psychological intervention, to examine participants' perspectives of their personal values. The motivation behind September's 'interruption' study was a need to be convinced through empirical evidence. The need to be convinced confirmed the voice of separate knowing (Belenky et al., 1986) as it regards the use of rational thought: "Separate knowers remain suspicious; but as they develop techniques for analyzing and evaluating arguments, they become less vulnerable to attack" (p. 105).

In response to the question about work-life balance, September recommended that women avoid overcompensating and asked men to assume an equal share of childcare responsibilities: "Men need to step up more, and women need to step up less." March and September challenged the status quo and believed that in engineering, men wielded power over women. It is possible that owing to participants' engineering background, a field that is based fundamentally on developing critical reasoning and problem-solving skills, the voice of separate knowing is expected to be dominant. For participants,

separate knowing is a powerful voice: “Anyone who speaks with the voice of reason—even a peasant or a student—has a right to be heard; and anyone who does not, whether a king or a professor, has no right to be heard” (Belenky et al., 1986; p. 108).

Social Learning Theory

Bandura’s social learning theory (1977) advanced an understanding about how people learn from each other through observation, imitation, and modeling. An example of the influence of social modeling on motivation—seen within the theme of *value of family support and friendships*—was found in December’s description of her mentor. December described her mentor as being a “good friend” and saw her as a role model: “She needed someone to watch her son who is two years old. She was one of the first people I saw who is able to do it all.” December’s favorable portrayal of her mentor alluded to the concept of vicarious learning (Bandura, 1977).

In response to a general question about relationships (“Looking back, what relationships have been important to you?”) and a probe asking participants talk about people who supported their success, participants endorsed the value of mentors. 10 participants used the term “mentor” in multiple contexts. To determine the significance of the term *mentor*, KWIC listing was created. KWIC analysis revealed that the term mentor was used 35 times, that it was used in a positive context, that participants valued having a mentor, and that mentors were generally male. Considering engineering is a male-dominated field, the revelation that most of the mentors were male was not unexpected.

January, March, May, June, and July said that their PhD advisor was not just their mentor in the formal sense but that the relationship was built on a foundation of respect

and trust. January described her mentor as being her role model: “My PhD advisor definitely, he was my role model and mentor.” June also saw her mentor as her role model: “Dr. [mentor name redacted] was my mentor and role model.” January spoke admiringly about her mentor:

> I had the pleasure of working with the department chair over there, and he's a wonderful major professor as well as now we are friends. And he's my mentor. My PhD advisor, definitely, he was my role model and mentor.

August had male mentors for both her undergraduate years and graduate school. She spoke appreciatively of her mentors:

> But I remember one of the things he told me one time was, “Don't sell yourself short,” and that's stuck with me all these years. And he was just really encouraging, and then when I got to grad school, I had another just wonderful mentor. And [/he/] is my dissertation advisor.

Participants felt that their faculty advisors were genuinely interested in helping them succeed and that the level of authenticity strengthened their trust and confidence in them; it is the reason they referred to them as mentors and role models. The subthemes of *mentoring reduces work stress* and *academic achievement and team projects boost confidence* emerged from participants’ descriptions of individuals with whom they relied on for expanding their professional networks (for collaborative research projects) and confided in for navigating sensitive issues. May described a time when she brought her baby into her PhD advisor’s office:

> I had my child in his office…scrambling around trying to find a pacifier on the floor. I mean, he was very supportive of and making sure that I finished my degree; and then you know, had success after that, too.

Similarly, August described her PhD advisor as someone who was interested in helping women succeed:

> I had a colleague that actually almost quit the PhD program, a female colleague who was being advised by somebody else. And when she was thinking of quitting, he actually talked to her and convinced her to continue; and she ended up finishing her dissertation under him. I think that was an example of his being interested in you know, mentoring women.

In the statements where participants regarded their mentors as role models, people who they admired and tried to imitate, the notion of vicarious learning (Bandura, 1977)—which is learning derived from observation—is exemplified. Their statements supported the body of literature that establishes mentoring as an effective strategy for retaining women in the STEM fields (Abriola, 2014; Amelink & Meszaros, 2011; Ibarra et al., 2013; Pereira, 2011). With regard to the gender of the mentors, eight participants had male mentors and two participants (June and December) had female mentors. This fact disconfirmed the findings from the study conducted by Rankins, Rankins, and Innis (2014), which emphasized the importance of access to same-gender role models to serve as mentors and reinforce the sense of belongingness.

Aside from being mentees, participants themselves served as mentors to their own students and other female colleagues. October stated: "I kind of served as a mentor for a

lot of undergraduates and even a couple of master's students during my PhD. And I found that I really enjoyed that mentorship of research." Participants mentioned how mentoring helped to boost their own self-confidence and allowed them to be introduced to a larger community. Their statements supported the conclusions from the Riney and Froeschle's (2012) study, where the primary theme was *academic stress* and the secondary theme was *professors' concern for them*. The primary and secondary themes are interrelated in terms of a causal relationship, wherein professors' concern for them referred to the genuine care and concern that reduced work stress.

Participants' perceived self-efficacy also affected the manner in which they managed the stressors in their lives, specifically in response to barriers. In terms of coping mechanisms, participants tried to manage stress, both in their home and work lives. However, it is important to note that two categories of barriers emerged from the data: *barriers (work)* and *barriers (self)*. The barriers (work) included elements of the environment that were not under participants' control, such as not being selected for leadership roles, feeling a sense of isolation because they are the lone female, or task-oriented activities. A major concern that was held by all participants was the research aspect of the tenure, as professors are expected to work beyond the 40-hour work week. This barrier poses limits on participants' time with family. September admitted that she has on occasion brought her child into her office. October disclosed that her career had an effect on her relationship with her spouse and child: "…he is taking a back seat to my son, and then my son has taken a backseat to work this year."

When asked to share about whether their efforts to balance work and home life had an effect on their physical and mental health, the theme of *protection and self-preservation* was manifested in participants' declarations that their academic work life was accomplished to the detriment of their own health. May described her tribulations of academic life as consuming all of her time:

> It's so time-intensive to be a professor, and I feel you know, I work all day, my kids go to bed, and then I work several additional hours after they go to bed. And so, I'm trying to figure out a way to not necessarily do that.

February shared that she experienced panic attacks for two and a half years and had to seek medical attention from a psychiatrist for anxiety management. April said, "I'm tired. I'm exhausted. I'm sleep-deprived."

In sharing stories of how they navigated the challenges of academic life while raising a family, participants admitted that dwelling on their ordeals caused them more distress. The theme of *unstructured work schedule and workplace climate* emerged from participants' anxieties about engineering academia and its impact on the well-being of both their family and their own health. Bandura's (1986) social cognitive model, in particular the concept of "triadic reciprocality" (p. 18), suggests a compelling argument for why there are so few women engineers. Bandura (1977) description of the constructs of the *environment*, *self*, and *behavior* can be considered in the context of self-reinforcing factors that steer women away from engineering. In this case, the self-reinforcing factors refer to participants' own inefficacious thinking. This supports Pappas' (2011) argument

that even among the most successful career women, considered *supermoms*, women are achieving greatness at the expense of their own health.

In response to the question about how mentors encouraged their success, two participants (September and November) gave no mention of having mentors and instead offered general explanations. September stated:

> You know I think that definition of success of like having a positive impact on the world really came from my parents. It had nothing to do with college or my professors or anything like that.

While September statement is the only one that negated the role of mentors, it does little to contradict that value that mentors provided to the other participants.

To avoid bias in research, the phrase *chilly climate* was not used in any of the interview questions; and instead the question was asked: "Can you describe the tone or climate of your workplace? What has your experience been in engineering?" November lamented about her current situation: "It's a poisoned environment, and it's a boys' club. And it's specifically [Middle Eastern ethnic group redacted] boys club, and that's not fun." Her statements are supported by studies that explored the concept of chilly climate for women in non-traditional career roles, such as those conducted by Malu et al. (2004) and Yonemura and Wilson (2016). Yonemura and Wilson's (2016) analysis revealed that *hostile culture* was more likely expressed by women, as opposed to *extreme work pressure*, expressed by both men and women. November's phrase "poisoned environment" epitomized this chilly climate and hostile culture. In connecting chilly climate and hostile culture back to theory, Bandura's (1977) theory of *reciprocal*

determinism expressed how a person behaves in relation to the environment, such that the person and the environment have mutual effects on each other. November conveyed feeling incensed and contemplated leaving her institution to avoid confrontation. This confirmed Bandura's (1977) belief that a person's behavior impacts the environment and in turn, the environment influences a person's behavior.

Limitations of the Study

This basic qualitative research study was designed to explore the experiences of tenured and tenure-track women engineering professors who resided in the United States. The limitations for this study were determined by the design of the study, which was developed for a unique, relatively hidden population, tenured and tenure-track women engineering professors with children. Due to the general scarcity of possible participants, this study was limited by the under-representation of individuals in the target population. Because I was the sole interviewer—thereby introducing the possibility of bias—I exercised great diligence in bracketing my biases and keeping a research journal; I consciously bracketed my biases and suspended judgment during the interview process. To limit bias during the interviewing process, I adhered to the interview protocol, avoided asking leading questions, and withheld commentary on participants' response until after the interview was completed. It is expected that any potentially adverse effects of preconceptions were mitigated through this bracketing process (Patton, 2015).

Due to the inherent nature of qualitative research, the generalizability of results is limited to the population in the selected sample (Creswell, 2007). So, the study findings cannot be generalized beyond the participants of the study; the findings cannot be

generalized to all women engineering professors with children. Given the self-selection of participants, it was anticipated that participants would include women engineering faculty who had concerns about the ability to attain tenure as a result of work-life balance challenges.

To strengthen the trustworthiness of this study, the transcript review process was incorporated in the data analysis plan. Five participants provided edited and then approved copies while seven approved the transcript as was provided. It is assumed that the seven participants who elected not to provide revisions simply found the transcript accurate.

Recommendations

There were four key findings from this study that influenced my recommendations for additional research:

- Participants experienced gender stereotyping in engineering academia;
- Participants recognized overlap between the tenure and biological clocks;
- Participants expressed a default arrangement in assuming the burden of childcare;
- Participants revealed that work-life balance is a false concept.

The pervasiveness and persistence of gender stereotyping in engineering academia continues to have undesired results on the number of women who enter engineering academia as well as those who are retained. Women in STEM academia represent about 18% of tenured and tenure-track positions (National Academies, 2010), and women's representation in engineering academia is about 15.7% (Yoder, 2017). According to the National Academies (2010), the representation of women at the full professor rank in

STEM academia is 21% in science but a mere 5% in engineering. How the presence of children impacts tenure and promotion is a question that few studies have attempted to address. Given the meager proportion of women in engineering academia, I recommend leveraging the expertise of principal investigators and directors of ADVANCE grants for acquiring additional data and developing collaborative research studies. ADVANCE is an NSF-funded program which seeks to develop and expand systemic methods for increasing the participation and advancement of women in STEM academia. Hence, there already exists a community of scholars and practitioners dedicated to the advancement of women in the STEM professoriate.

As confirmed by participants' own sentiments, they deemed the biological time clock to be a barrier to attaining tenure. Because there is overlap between the tenure and biological clocks, women are confronted with the dilemma of having to decide whether to start a family or enter a career in engineering academia. The U.S. Census Bureau (2011) used the term *delayer boom* in reference to women with college degrees bearing children at a later age (para. 1). While the ubiquitous *stop-the-clock* [on tenure] policy was originally designed to serve women, a recent study by Antecol, Bedard, and Stearns (2016) reported that men were the primary benefactors. This is a result of policies written to be gender-neutral to comply with federal and state laws regarding protected categories. However, many would argue that the biological process of giving birth is not gender-neutral. Women with children do not represent the ideal academician, but they are still viewed as individuals who work around-the-clock uninterrupted. Unfortunately, this norm disadvantages the child-bearing woman whose biological clock does not coincide

with the tenure clock. Based on this study's findings, I recommend that future studies on the biological time clock include a time series design to explore how institutionally supported career interruptions (i.e., maternity leave, FMLA programs) and structured tenure support systems (i.e., stopping the tenure clock, job-share agreements) affect women's progress toward tenure and promotion.

In this study, participants expressed a default arrangement in assuming the burden of childcare and willingly accepted the burden as a dimension of their obligation as a mother and their identity as a mother. They did not want to relinquish the role of the mother even in the face of work conflicts. Among the 12 participants, two participants are divorced single mothers, and one participant had a spouse who was a stay-at-home father. Given the responses of nine participants, who had spouses employed in the STEM fields, it was not possible to conjecture whether these participants or their spouses had the more time-demanding work schedule. I recommend that future studies recruit women engineering professors whose spouses include those who are stay-at-home fathers and those who are not employed in the STEM fields.

In 2016, women's participation in the labor force was 56.8%, as compared to men's participation at 69.2% (Bureau of Labor and Statistics, 2017). Despite the steady increase in women's employment rate, women's representation in workforce readiness and in the STEM fields continues to be meager (National Academies, 2010; National Science Foundation, 2017; National Society of Professional Engineers, 2015). Cultural norms that influence women's choice to favor certain careers over others have resulted in women's reluctance to pursue non-traditional careers, such as engineering and

engineering academia. Prominent among cultural norms is the concept of women's unpaid labor, specifically referring to domestic work in the home, such as childcare and household chores. A new study (United Nations Women, 2018) estimated that women do 2.6 times more unpaid domestic work than do men. This is significant because formal paid work is recognized and provides a sense of fulfillment, while informal unpaid work is generally taken for granted and under-appreciated.

Because social norms present women as caregivers, their informal unpaid work as mothers to their children is in essence gendered (Navaie-Waliser et al., 2002). The participants in this study reported feeling that their responsibilities in the role of the mother should take precedence over their expectations in the role of the engineering professor. To overcompensate for this role conflict, participants described how they tried to incorporate their children into their work schedule. However, they expressed that this was not an ideal situation given the current rigidity in engineering academia. Without the condition of a flexible schedule, work-life integration may not always be possible. I recommend that additional studies explore creative solutions for adjusting meeting formats in engineering academia that reflect family-friendly practices, such as using technology (e.g., augmented or virtual reality) for late-evening meetings.

Finally, participants revealed that work-life balance is a false concept. Missing in the work-life balance concept is the notion of women's unpaid labor, specifically referring to domestic work in the home (i.e., childcare, household chores). Participants did not see their work as tied to the workplace. Their statements exposed the folly of work-life balance; there is no real equilibrium. For example, August's account of her

total work time per week—including time at her university in the role of the engineering professor (60 hours) and time at her home in the role of the mother (40 hours)—demonstrated that she worked a total of 100 hours. This particular finding altered my original thinking about work-life balance. The work-life balance concept is a binary framework that differentiates *work* and *life* as fundamentally discrete concepts. The participants in this study chose to become engineering professors and at the same time, they also chose to be mothers. They see both roles as life-long commitments but not different commitments. Rather, the two roles are different representations of how each participant sees herself in life. Participants decided that career goals and life choices should not be competing forces but rather, they should be complementary and integrated.

Implications

Given that and women's representation in engineering academia is about 15.7% (Yoder, 2017) and their representation at the full professor rank in STEM academia is a mere 5% in engineering (National Academies, 2010), this study provided data that may be contribute to future research on the under-representation of women in the engineering professoriate. This study's results revealed that engineering academia does not currently offer a tenure structure that is conducive to supporting women professors with young children. Given that the work-life balance concept has been refuted by this study's participants, perhaps this study serves as a call to action for higher education administrators to consider revitalizing conventional initiatives that involve work-life conflict. If higher education administrators are interested in recruiting and retaining women in tenured and tenure track engineering positions, the discussion must now

revolve around work-life integration. The opportunity to move away from programs and policies, that offer accommodation for working mothers or only briefly stopping the tenure clock, is presented to senior management to review a new perspective and consider a paradigm shift that will attend to integrating the family into the organization.

Conclusions

Given the dearth of women engineering professors, as well as the overall shortage of women STEM professionals, I was originally motivated to explore the work-life balance concept in this target population with hopes of discovering ways to mitigate some work-life balance challenges. Immersed in the meaning-making stage of the interview, as well as reflecting on post-transcript feedback provided by the participants, I learned from them that the concept of work-life balance is unhealthy and unrealistic. Participants described struggling with trying to negotiate time for family and work; this was reflected in numerous testimonials that described how their psychological and physical health were affected. Participants shared intimate details about failed attempts of trying to embrace the responsibilities of being a mother while fulfilling the requirements of academic tenure and promotion in their professorial role. In their determination to balance the responsibilities of two identities—the role of the mother and the role of the engineering professor—participants discovered what worked and what failed. Still, their creative strategies were short-lived and temporary; and such strategies did little to mitigate the challenges and expectations of engineering academia.

Among the key findings, the most significant was that participants found work-life balance to be inconsistent with their experiences They described experiences in terms

of work-life integration. Unable to balance family and work life, they had difficulty managing their health and well-being with childcare and household obligations. Even among the most self-confident, the phenomenon of the *supermom* (Pappas, 2011) engulfed participants' sense of what they considered reasonable. The voice of *separate knowing* (Belenky et al., 1986) did not safeguard them from working excessive hours—a result of overcompensating for childcare and household tasks—which they pursued to the detriment of their own health. Participants felt obligated to fulfill duties in the role of the mother; and in doing so, they described their spouses as being stunted in terms of caregiving tasks and unable to contribute equitably to household chores.

Participants' gendered use of time exhibited traditional male-female power relationships in gender-segregated divisions of labor in the home (Beddoes & Pawley, 2014). While there may be biological tendencies for women to assume the burden of childcare, there are no biological determinants for household chores. Studies confirmed that 50% of working women, as compared to 20% of working men, do household chores (American Time Use Survey, 2018). With working women doing 1 ½ week's more household chores per year than their spouses (Milkie, Raley, & Bianchi, 2009), there may be one rational explanation: women's disproportionate household work is a gendered expectation. To support women in engineering academia with children, spouses must reconcile an outmoded perspective on the working mother; they must learn to contribute equally to the obligations of the household. Using September's recommendation, "Men need to step up more, and women need to step up less."

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Appendix: Interview Protocol

Research Question: What are the experiences of tenured and tenure-track women engineering professors regarding family formation, child-raising, and the tenure process?

Women's Ways of Knowing

(Adapted from the full interview protocol found in Belenky et al., 1986, pp. 231–234)

Introduction: Thank you for agreeing to be a participant for my research project. The main research question is: "What are the experiences of tenured and tenure-track women engineering professors regarding family formation, child-raising, and the tenure process?" This interview will take no more than 90 minutes and will include 5 general questions that will help me learn more about you and 8 main questions with several sub-questions; these questions will be categorized in three stages. The first stage will focus on your life history, the second stage on the details of your experiences, and the third and last stage will be for you to reflect on the meaning of your experiences as a woman engineering professor.

I would like your permission to tape-record this interview so that I may accurately document your responses. If at any time during the interview you wish to discontinue the use of the tape recorder or the interview itself, please feel free to let me know. Your responses are confidential. After the interview, I will provide you with a transcript of your interview. This is so that you may review what you shared, provide me with feedback, and reconcile any discrepancies of the interview.

I would like to remind you of your written consent to participate in this interview. I am the responsible investigator for this research project: "Work-life Balance of Tenured and Tenure-Track Women Engineering Professors." We have both signed and dated two copies of the written consent certifying that we agree to continue this interview. You will receive one copy, and I will keep the other under lock and key, separate from your documented responses.

Your participation in this interview is completely voluntary. If at any time you need to stop or take a break, please feel free to let me know. You may also withdraw your participation at any time without consequence. Do you have any questions or concerns before we begin? With your permission, we will begin the interview.

General Questions—Learning About the Participant
(Ask participants to introduce themselves)

General Question 1: Background: Tell me about yourself (your education, your job)? What stands out for you in your life? What kinds of things are important to you? What do you care about?

General Question 2: Self-Descriptions: How would you describe yourself? Do you see yourself different from the way you saw yourself in the past?

General Question 3: Gender: What does being a woman mean to you? Do you think there are important differences between women and men engineers, engineering educators?

General Question 4: Relationships: Looking back, what relationships have been important to you? Why? Describe a relationship you had with someone who helped shape the person you are today? How would you describe your mother (or primary caregiver)? Your father? Your child(ren)?

General Question 5: Has being in engineering changed the way you think about yourself or the world? If so, can you tell me how? Can you tell me about a powerful learning experience that you've had in or out of career in engineering education?

Stage 1 Questions—Focused Life History
(Asks participants to share their life experiences relevant to career path)

Interview Question 1: Tell me how you got to where you are today in your current position as a woman engineer. Go back chronologically as far as you like.

- Probe Question 1a: How long have you worked in your current position?
- Probe Question 1b: Current position details (i.e., tenure status, work details).

Interview Question 2: Let's talk about your childhood years.

- Probe Question 2a: Where did you grow up, go to school?
- Probe Question 2b: Recall an early experience (home, school, other) that inspired you to become an engineer.
- Probe Question 2c: Describe your home-life. Did your parents/guardians encourage/support your career choice?

Interview Question 3: Let's talk about your college years.

- Probe Question 3a: Where did you go to college? What degree did you earn?
- Probe Question 3b: What does success mean to you? Describe your experiences in college and what you think contributed to your success.
- Probe Question 3c: Talk about any professor, mentors, role models who supported/encouraged your success.

Interview Question 4: Let's talk about your workplace.

- Probe Question 4a: Can you describe the tone or climate of your workplace. [Only if participant requires prompting, then use the terms *friendly, supportive, competitive, hostile*.]
- Probe Question 4b: What kind of services, if any, does your employer offer in terms of support for career advancement?
- Probe Question 4c: Describe your supervisor, your colleagues, and your relationship with them.
- Probe Question 4d: Do you currently hold a leadership role? Have you held a leadership role?

Stage 2 Questions—Details of Experiences

(Offers participants opportunity to reconstruct experiences in detail relevant to climate and work-life balance. Listen for procedural knowing, separate and connected.)

Interview Question 5: Describe your work environment. What are the best and worst aspects of your current job?

- Probe Question 5a: How did you or others respond, address, or mitigate issues?
- Probe Question 5b: Describe some situations that made you feel valued, devalued, or that you have a voice in department decisions. [Only if participant requires prompting, probe if this is not mentioned earlier.]
- Probe Question 5c: Are there other examples?

Interview Question 6: Let's talk about work-life balance.

- Probe Question 6a: Tell me about any commitments outside of work and how you are able to balance these commitments.
- Probe Question 6b: Tell me about your partners/spouse, children/dependents.
- Probe Question 6c: Dual career, Primary/Secondary Earners. How are responsibilities shared?
- Probe Question 6d: How do these commitments affect your work (i.e., ability to attend late meetings)?

Stage 3 Questions—Reflection on the Meaning

(Guides participants to reflect on the significance of their lived experiences and consider how such experiences shaped their lives. Listen for procedural knowing, separate and connected.)

Interview Question 7: Do your efforts to balance work and home life/interests have an effect on your physical and mental health? If so, in what way?

- Probe Question 7a: Would you consider this/these effect(s) to be positive or negative?

Interview Question 8: Do you think gender has played a role in your career as an engineering professor? If so, how?

- Probe Question 8a: In what ways do you think gender affected your early career aspirations, experiences, planning, current work experience? [Depending on participant's response, rephrase this question.]
- Probe Question 8b: Since gender did not play a significant role in your career as an engineering professor, please describe what you think were significant factors. [Depending on participant's response, use this question.]
- Probe Question 8c: Many women leave engineering, what keeps you here?
- Probe Question 8d: Have you observed differences between career choices or paths of women and those of men in engineering? Can you describe those?