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# Men and Women in Engineering: Professional Identity and Factors Influencing Workforce Retention

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Men and Women in Engineering:  
Professional Identity and Factors Influencing Workforce Retention

Caitlin Hawkinson Wasilewski

A dissertation submitted in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

In

Industrial/Organizational Psychology

Seattle Pacific University

May 2015

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**Dedication**

To my two favorite engineers in the world:

My Papa, Ray Yerden

&

My Husband, John Wasilewski

Thank you for your incredible contributions to aerospace engineering and the legacy you have left to this field. I love and admire you both.

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Caitlin Wasilewski

334 words

### Abstract

The purpose of this investigation was to gain insight into professional identity and retention in the field of engineering, for both men and women, in an effort to mitigate the shortage of engineers in the United States. Although past efforts have predominantly focused on improving women's retention since they represent a significant minority of this population, retention should be addressed in men as well, as both typically leave engineering within 10 years of entering the workforce (Frehill, 2012).

Professional identity and retention were evaluated with a mixed methods approach using archival data from a previous investigation on degreed engineers. Professional identity was measured by an online survey taken by all 891 participants (53.6% female, 46.4% male). A subset of 61 participants (60.7% female, 39.3% male) were also interviewed about their experiences in engineering.

The results indicated professional identity is significantly correlated with persistence in the field  $r_{pb} = .142, p < .001$ , with those who persisted in engineering scoring higher on professional identity than those who left. Tests conducted within gender indicated statistically significant differences between those who stayed in the field and those who left, for both men  $t(101.17) = 1.994, p = .045, d = .25$  and women  $t(297.28) = 3.168, p = .001, d = .30$ , with those who stayed scoring higher on professional identity in both genders. However, no gender difference in professional identity was found  $t(886.95) = -1.448, p = .148, d = .10$ . A grounded theory analysis of the interviews highlighted the personal importance and meaning individuals felt with regards to their identity as engineers, as well as the similarity in the factors contributing to retention and turnover in men and women. A social identity approach was applied to the identity themes and offered a

valuable framework for the findings. The similarity found between men and women suggests interventions targeted to these common factors could improve retention in the field overall, and have a substantial impact on retention, and therefore the number of engineers in the United States.

*Keywords:* engineers, professional identity, retention, turnover, men, women

## CHAPTER I

### Introduction

The United States has led the world in science and technology, yet the shortage of scientists and engineers in America has become a serious threat to the country's security and position as a global leader. Current projections indicate that within the next decade there will be an additional 1 million jobs in the STEM (science, technology, engineering and math) fields that need to be filled (Hewlett et al., 2008; Olson & Riordan, 2012). These projections are particularly concerning as the number of degrees earned each year in STEM fields have been declining since 2001 (Olson & Riordan, 2012). Engineers are a critical population of STEM professionals to study due to the critical nature of their work to the country's competitive edge, as technological innovation is a key driver of the economy (Fouad & Singh, 2011; Frehill, 2012). Efforts to mitigate the shortage appear to focus on one of two options; either (a) improving recruitment into engineering degrees so there is a greater pipeline of engineers available to do the work, or (b) increasing retention, both in college and the workforce, so that those already interested in the field are more likely to stay. The majority of research conducted on these strategies has tended to focus on women, college students, and those in the academic sector. As a result, much less is known about practicing engineers as a whole (Meiksins, Layne, Camargo, & Snead, 2013; Meiksins et al., 2015), and the experiences of men, who comprise the majority of this workforce.

Engineering is the most male-dominated nonmilitary profession in the United States (Buse & Bilimoria, 2014; Cech, Rubineau, Silbey, & Seron, 2011) with women representing only 11.7% of the engineering workforce as of 2013 (National Science Foundation [NSF], 2013). Women are greatly outnumbered by men in all engineering fields, both in the workplace (Cech et al., 2011; Fox, Johnson, & Rosser, 2006) and in college (Litzler, 2010). Women also tend to leave the field up to twice the rate of men (Frehill, 2012). Turnover for women is puzzling, as most who consider

leaving their organization also think about leaving the field of engineering entirely (Fouad, Singh, Fitzpatrick, & Liu, 2012; Fouad, 2014). Explanations for the gender gap often focus on family-related reasons, but it appears that family factors alone do not fully explain high turnover rates for women in engineering. A pattern in retention that has been noted in recent years is that women who persist in the field seem to identify strongly with engineering (Buse, Bilimoria, & Perelli, 2013; Plett, Hawkinson, VanAntwerp, Wilson, & Bruxvoort, 2011), while those who leave tend to blame the masculine culture of the field for their departure (Hewlett et al., 2008). This may indicate that the culture of engineering acts as a barrier to professional identity formation, making it harder for women to see themselves as engineers. This pattern of professional identification should be investigated further to evaluate its influence on retention in the field and extended to men, to see if professional identity is related to persistence in this population as well.

Considering that men are the clear majority in engineering, there has been little impetus to focus on improving their retention or analyzing patterns in their careers. This approach is problematic as it assumes all 1.8 million male engineers in the US (NSF, 2013) identify with the culture and stereotype of engineering. However, some research evidence suggests that the environment of engineering may be difficult for both men and women. In comparing the top two reasons given for leaving engineering, “working conditions” were cited nearly equally by men (14%) and women (15%) (Frehill, 2012). Furthermore, Mills, Mehrtens, Smith, and Adams (2008) found that 19% of Australian male engineers reported workplace bullying, and Frehill (2009) found that 5% of men left the field because of “negative work climate issues.”

While past research in this area has tended to focus on women because of their minority status in the field, if we assume all men fit in engineering simply because it is a male-dominated field, we ignore the fact that some men may not like the culture and that there might be minority populations of male engineers who are at an increased risk of leaving. Rather than assuming the



culture of engineering is only difficult for women to navigate, we should consider that it may also have effects on men and influence their retention. The purpose of this dissertation is to address this gap in the literature by investigating the experiences of both men and women who have earned engineering degrees, specifically focusing on the role of professional identity on retention in the field of engineering.

Identity refers to an individual's conceptualization of himself or herself, which is based on many factors including their beliefs, values, and experiences (Ibarra, 1999). Professional identity focuses specifically on how individuals define themselves in terms of their professional roles, and in the case of this investigation, refers to individuals' perceptions of themselves as engineers. When people identify with a group it facilitates their attachment and commitment to the group, while reducing their intentions to leave (Ellemers, Spears, & Doosje, 1997; Stets & Burke, 2000). As a result, identification could be especially important for minority group members who may find it difficult to see similarity between themselves and majority members, limiting their propensity to classify themselves as part of the group.

In the remainder of this literature review, I discuss the culture of engineering to provide context for the environment in which engineers work and develop professional identity. The literature on professional identity and its development will be evaluated as well as challenges to identity development associated with minority status, which likely affects identity development in this field. I will also discuss social identity theory and cognitive dissonance theory as they offer potential explanations for the importance of identity in engineering retention as well as why some opt to leave the field entirely. These theories, applied to both men and women, may help us understand the experiences of this population and improve retention rates in the field.

## Literature Review

### The Cultural Identity of Engineering

Several studies have assessed the environment in engineering and have found it to be a strong and highly gendered culture. Hewlett et al. (2008) referred to the culture found in engineering as a hostile macho culture where value is placed on “masculine interaction styles such as aggressive displays of technical ability, self-promotion and self-confidence” (McIlwee & Robinson, 1992, p. 177). A job in this field requires a college degree in engineering, which is known to be highly rigorous and competitive. In addition to proving competence by earning a degree, McIlwee and Robinson (1992) noted:

Competence as an engineer is a function of how well one presents an image of an aggressive, competitive, technically oriented person....To be taken as an engineer is to look like an engineer, talk like an engineer, and act like an engineer. Of particular importance in this presentation of self is the image of hands-on competence. (p. 20–21)

This emphasis on hands-on and technical work is so central to the identity of engineering that jobs that do not include these specific aspects are often not considered engineering jobs by those in the field. Even management in engineering firms is not considered “real” engineering work because it does not include these aspects (Faulkner, 2007). The focus on hands-on and technical work is so central to the culture of engineering that Faulkner (2009a) noted many men cling to this identity even when their job does not require the use of tools.

The humor and interaction styles found in this field also add to the aggressive nature of the culture. Humor in the field has been found to be degrading and hostile with everyone expected to give and take jokes of this nature (Collinson, 1988; Watts, 2007). Others have found that humor in engineering is often also sexual in nature or sexist (Faulkner, 2009a). Collinson (1988) described the use of aggressive and hostile humor in the field as a pervasive aspect of the culture in which

employees were expected to insult themselves and others in order to fit in. Humor was often used as a way to keep people in line and make sure everyone pulled their weight. These types of interactions, while framed as humor, can have negative consequences on employees and create a hostile and uncomfortable environment. This attachment to the identity of engineering, which values masculine interaction styles and technical, hands-on competence, creates challenges for those who do not behave in this manner or see themselves this way.

### **Social Identity Theory**

Social identity theory (SIT) is a “social psychological analysis of the role of self-conception in group membership, group processes, and intergroup relations” (Hogg, 2006, p. 111). According to this theory, individuals define themselves through both social and personal identities. Social identity involves an individual’s knowledge of his or her belonging to a social group or category (Stets & Burke, 2000), whereas a personal identity is an individual’s self-perception of the idiosyncratic characteristics that are unique to them and not shared with others or involve relationships between them and another specific individual (Hogg, 2006). Central to SIT is the idea that people engage in cognitive activities to classify themselves and others into social categories or groups (Ashford & Mael, 1989; Reicher, Spears, & Haslam, 2010; Spears, 2011).

A group is defined as three or more people who see themselves as having shared attributes which differentiate them from others (Hogg, 2001; 2006). It is through cognitive processes that individuals compare themselves to group members to evaluate whether they are part of a particular group or not. Group members “identify and evaluate themselves in the same way and have the same definition of who they are, what attributes they have, and how they relate to and differ from people who are not in their group or who are in specific out-groups” (Hogg, 2006, p. 115).

Cognitive representations of groups are referred to as prototypes, which define the behaviors and characteristics of the group and emphasize the similarities between in-group members as well as

their distinctiveness from out-group members (Hogg, 2006). Within prototypes are group norms, which define the behavior, attitudes, and perceptions expected of members. When people are new to a group they are socialized by its members to teach them how one is to behave and interact in that particular group, to which new members are expected to conform (Heppner & Fu, 2011). Upon observing patterns of behavior, those who self-identify with a group are more likely to conform to the group's norms (Ashforth & Mael, 1989) and therefore be a better fit with the group than those who do not see the group as part of their identity. Those who conform and behave prototypically will be seen as group members and therefore part of the in-group. In contrast, those who do not conform to the norms taught through socialization are at greater risk of stress-related outcomes, low commitment, and high turnover, which has negative implications for both the individual and their organization (Ashforth, Harrison, & Corley, 2008).

Identification with a group changes an individual's perceptions not only of the group itself, but of those outside the group as well. The process of self-identification with a group highlights to the individual the similarities between him or herself and the members of the group, and emphasizes the differences between the self and out-group members (Hogg, 2006; Hogg & Terry, 2014; Stets & Burke, 2000). When an individual identifies with a group they tend to evaluate in-group characteristics more positively than out-group characteristics. These positive evaluations of the group will increase the individual's self-esteem, encouraging them to continue associating positive qualities with the in-group and negative characteristics with out-groups (Hogg, 2001; 2006). Not only are out-groups seen more negatively, they are also assumed to be more homogenous than in-group members (Lalonde & Gardner, 1989).

Identification with a group leads to a boost in self-esteem which motivates people to associate positive qualities with the in-group and look unfavorably upon out-groups (Hogg, 2006). In the case of engineering, those who identify as engineers should experience an increase in self-

esteem as a result of identification, and therefore, be motivated to view engineers positively and non-engineers negatively. Identification with a group also leads to greater commitment, and therefore reduces an individual's desire to leave the group (Ellemers et al., 1997; Stets & Burke, 2000). If an individual does not identify with other engineers, they may come to see engineers as the out-group. Since out-groups appear homogenous and are viewed negatively, when considering their dissatisfaction with the job, the environment, or a lack of belonging, they may not see other engineering jobs or companies as an option, as in their mind, all engineers are the same so moving within the field would not make a difference. This may explain why some leave the field of engineering entirely rather than changing jobs or companies within the field. In contrast, those who consider themselves an engineer and identify with this group will see themselves as similar to other engineers, giving them a sense of belonging that makes them want to stay in the group.

Identification with engineering may be particularly important for minority groups in this field who perceive a lack of belonging. Identification with engineering (i.e., the majority group), will likely help minorities see themselves as group members, rather than focusing on how they differ from the majority, and facilitate their commitment and desire to maintain their group membership by staying in the field.

People have multiple identities due to the many groups and relationships in which they are involved (Hogg, 2006; Stets & Burke, 2003). Conflict can arise between an individual's various social identities as well as between their personal and social identities, when the "values, beliefs, norms, and demands inherent in the identities" are challenged (Ashforth & Mael, 1989, p. 29). Identities differ in importance and accessibility for each individual (Spears, 2011). According to SIT, only one identity tends to be salient at a time and will change when the context or situation changes (Hogg, 2006).

## Professional Identity

One aspect of an individual's identity is the way in which he or she defines him or herself through their work or professional role. Identity within the context of work has been defined in many ways and at several different levels including identification with one's occupation, career, profession, or the organization they work for. SIT has been applied to identity within the work context through organizational identity in which people define themselves by the organization they work for (Ashforth & Mael, 1989), and more recently at the level of the occupation (Ashforth, Joshi, Anand, & O'Leary-Kelly, 2013). The aspect of identity assessed in this investigation is professional identity, which will be defined as "one's professional self-concept based on attributes, beliefs, values, motives, and experiences" (Slay & Smith, 2011, p. 85). This definition of professional identity may differ from others found in the literature as there are a number of definitions in existence. However, this definition appears to best fit the construct under investigation. Professional identity is appropriate for this study because it focuses on identity at the level of the profession, which appears to be a factor in retention in the field of engineering for women (Plett et al., 2011, Buse, 2009; Buse, 2012; Buse et al., 2013). This definition also fits well with social identity theory as it captures the idea that professional identity is based on an individual's *self-concept*, and therefore, it is their own cognitive construction that defines group membership.

Identity with one's profession (or occupation) can be a strong form of identification. The strength of professional identity is likely due to the salience of one's profession, facilitating its integration into the self-concept. According to Ashforth et al. (2013), an individual's profession can be more salient or important to them than organizational identity "because one's occupation tends to be more cognitively proximal (vs. distal), concrete (vs. abstract), and exclusive (vs. inclusive) than one's organization" (p. 2426). In addition, the fact that individuals are hired by a company to perform the work of their profession makes it a salient aspect that differentiates them from others in

the organization (Ashforth et al., 2013). Professional identity is likely to be a critical component of an individual's sense of identity at work and a potential influence on their behavior.

**Professional identity development.** Slay and Smith (2011) identified three mechanisms of professional identity development in the extant literature: socialization processes where one learns about the meanings of the profession (Fine, 1996; Hall, 1987), clarification of priorities and self-knowledge through life and work experiences (Schein, 1978), and adaptations during career transitions (Ibarra, 1999; Nicholson, 1984). Each of these mechanisms of professional identity development will be considered below.

***Professional identity through socialization.*** The first means of professional identity development, in which an individual learns about the profession through socialization, is a critical aspect of engineering education at the college level. The development of professional identity as an engineer has been documented during the college years in engineering students and is associated with retention in engineering majors (Pierrakos, Beam, Constantz, Johri, & Anderson, 2009) and positive development towards becoming an engineer. According to Chachra, Kilgore, Loshbaugh, McCain, and Chen (2008), in order to develop a professional identity, engineering students must come to identify with the field by gaining an understanding of what engineers do and accepting the characteristics of the identity of an engineer.

The manner in which engineering programs tend to be structured has a significant effect on the socialization of engineering students, which aids in their identification with the field.

Engineering students are often seen as different from other students even within the same academic institution largely due to the culture and structure of engineering school. Engineering programs can have the effect of isolating students somewhat from the rest of the school as the majority of classes are taken within the major in a fairly strict sequence (Chachra et al., 2008). In addition, the rigor of the courses and the need for collaboration to succeed in the program serve to foster camaraderie in

students (Chachra et al., 2008; Dryburgh, 1999) that is fairly unique to these majors. Engineering students report an increased sense of identification and solidarity with other engineering students throughout the college years and report greater differences between themselves and other non-engineering students (Stevens, O'Connor, Garrison, Jocuns, & Amos, 2008). This differentiation between engineering and non-engineering students is seen even in freshmen year, as engineering students refer to other engineers as “we” and others as “they” (Stevens et al., 2008; Loshbaugh & Claar, 2007; Matusovich, Streveler, & Miller, 2010). In terms of social identity theory, this “we” vs. “they” language, increased sense of identification with other engineering students, and perception of differences from other students would indicate they are classifying themselves and identifying with engineering during the college years.

Identification with engineering may also be strengthened by the fact that others refer to engineering students as ‘engineers’ which is rare to do at the college level. As Chachra et al. (2008) points out, we do not refer to history majors as historians, but we often refer to engineering students as engineers, even early in their studies. According to SIT, “the groups we belong to profoundly influence how others know us- they are the lens through which people view us” (Hogg, 2003, p. 462). It is likely that others identifying and referring to engineering students as engineers may increase their sense of identification with the profession as it validates that others see them as part of this group as well.

A critical component of professional identity development in engineers is exposure to the field and what a career in this area would entail. This is achieved largely through practice and exposure in engineering tasks and activities. Experience and exposure to activities of this nature are a source of gender disparity which may hinder professional identity development for women as they are less likely to have engaged in these types of activities prior to college (Chachra et al., 2008). As a result of gender role socialization, boys are more likely to have engaged in tinkering and hands-on



activities than girls because it is considered gender-appropriate for them (Hackett & Betz, 1981).

This gap in hands-on experience is problematic for girls as they begin engineering degrees and find the men have more experience with these types of activities, which lowers their confidence and sense of belonging (Chachra et al., 2008). This discrepancy in experience, in a field that prides itself on hands-on technical competence, may put women at a disadvantage and make them feel different or question their fit. This may also be true for men who enter college with less experience with these types of activities than the majority of their classmates.

Gender differences are also found in the way college engineering students define engineering which has potential implications for identification. According to Chachra et al. (2008), men are more likely to describe engineering as highly technical and involving the application of math and science. They are also more likely to associate building and design activities with engineering than women. Chachra et al. also found gender differences in sophomore engineering students with regards to their scores on a measure of professional identity. The study found that men reported higher levels of public regard, meaning they believe others have more positive views of engineers or engineering than women do, but women were found to rate higher on centrality, indicating they more strongly define themselves as engineers than male students. Chachra et al. caution that gender differences in how engineering is defined and the way men and women rate components of their professional identity may indicate they are not identifying with the same engineering. The way in which each gender defines engineering is thus an area in need of further investigation.

The development of a professional identity as an engineer during college may ease the transition into the engineering workforce. If an individual feels like an engineer and identifies with this group and the activities associated with the profession, they may find the move into the workforce to be less of a challenge. This should be especially true for those educated in

environments that are highly similar to the workplaces they enter, as less adaptation and conformity will be necessary than for those who experience more drastic changes in culture.

***Professional identity development through life and work experiences.*** The second component of professional identity development involves the effect of life and work experiences in shaping an individual's knowledge of themselves and their priorities (Schein, 1978; Slay & Smith, 2011). In one of the few studies conducted on professional identity in practicing engineers, Hatmaker (2012) found that both genders use strategies, which she called role configuration, to construct a professional identity they feel comfortable with. This study identified three patterns of role configuration through which engineers manage their professional identity: role balancing, role grafting and role swapping.

The first strategy, role balancing, was typically employed by individuals in an effort to present a desired professional image in the workplace that was consistent with their self-concept. According to Goffman (1959), people try to manage the impressions others have of them and can do so by embracing or distancing themselves from particular aspects of a role. Distancing occurs when people are expected to behave in ways that are inconsistent with their self-conceptions and results in them denying or downplaying the role to prevent it from being associated with them (Goffman, 1959; Hatmaker, 2012). In contrast, embracing involves the individual accepting or investing in the identity.

Women in Hatmaker's (2012) study often used role balancing to distance themselves from stereotypical engineers who are good at math and science but lack social skills, a role she refers to as the techno role. Those who distanced themselves from this role did so because they felt it was incongruent with their sense of self or the image they wanted to communicate in the workplace. These women did not want to distance themselves from the technical aspects of the job or doubt their ability; they wanted to distance themselves from the asocial image associated with engineers.

These individuals tended to embrace and emphasize other traits they possessed that were more consistent with their self-perception, especially those that had a social component. By distancing themselves from elements of engineering they found inconsistent with their self-concept, and embracing traits that better fit their perceptions, these women were able to establish their professional identity in a way that was consistent with their sense of self. While none of the men in Hatmaker (2012) tried to distance themselves from the techno image, some also found this role alone limiting and emphasized the need for other skills, such as communication, in addition to being technical. These strategies allowed individuals to shape their professional identity in a manner that was consistent with how they saw themselves and the skills and abilities they valued in their work.

The second strategy, role grafting, mainly differed from role balancing in that the techno role was not something Hatmaker's (2012) participants tried to distance themselves from but was core to professional identity. Those who used this strategy did not express concern with the techno image and emphasized the value of the knowledge and skills of this core. Role grafters maintained this core but added new skills or roles to their professional identity. The addition of skills was often in response to role transitions in which they learned they needed to supplement their technical core by adding to their repertoire. Interestingly, none of the men in the study reported using this strategy. Hatmaker (2012) noted this is somewhat surprising considering the extent to which research says men cling to the techno identity, but says this could be because this identity is taken for granted in men since it is gender-consistent for them. Women may have to be more intentional about integrating the technical core into their identity and as a result, be more likely to discuss it.

The final professional identity development strategy identified by Hatmaker (2012) is role swapping in which participants reported using different roles in different situations. Individuals who reported using this strategy did not appear to distance themselves from any of the roles or be any more comfortable with particular roles; they seemed to identify equally with the various aspects of

being an engineer. Those who used role swapping adapted the role they played depending on the situation and moved the appropriate role to the core of their identity when in a particular context. The other aspects of their identity would move to the periphery as a result of the temporary movement of a particular role to the core and they were able to rotate through these roles as the situation called for without any distress (Hatmaker, 2012).

Events in one's personal life can also affect professional identity and have an influence on an individual's priorities. Whether it be through learning about oneself or changes in life circumstances, individuals may modify the course of their career trajectory or their sense of identification in certain areas of their lives. Frehill (2012), for example, found that 26% of women cited a "change in career or professional interests" as the most important reason they left engineering. There may be people who study engineering in college and enter a career in this field before learning about other areas that would be interesting to them or a better fit. As a result, they may leave their career upon identifying a new interest to pursue something other than engineering.

Furthermore, experiences and circumstances in life may highlight to an individual what is important to them, shape who they want to be or how they see themselves. The birth of a child, for instance, may make a man's identity as a father more salient or important to him than his identity as an engineer, and make him want to focus his energy on his family instead of his career. This experience could lead the new dad to leave engineering entirely if he feels his identity as a father is incongruent with his professional identity as an engineer, or it could motivate him to manage his roles so that both can be integrated into his identity. Those who manage their roles can construct and communicate an image of themselves they see as more consistent with their self-image which may help them stay in the field.

***Professional identity development during career transitions.*** Career transitions are a critical time in the development and adaptation of professional identity. During career transitions

one has to observe the behavioral norms of the new group and learn how to operate effectively in the new role. Typically, some degree of adaptation is necessary in a work transition as groups and work roles have different behavioral norms and expectations. During this time of adaptation the person tries to learn the prototypical traits, characteristics, behavior, and interaction styles in order to better fit the role or work environment (Ibarra, 1999; Ibarra & Barbulescu, 2010; Nicholson, 1984). One way in which this is accomplished is through the use of provisional selves, which are *temporary* constructions people use when adapting to new roles. With provisional selves, people “try on” different identities and assess their fit in an effort to improve their suitability within the organization (Ibarra, 1999). In forming provisional selves, people observe norms and often use role models as a means of learning the types of behavior and interaction styles used by those in the role (Ibarra, 1999). Individuals then evaluate these provisional selves using both internal and external feedback, and use this information to further refine these identities. Both implicit and explicit external feedback from organization members is considered by the newcomer as they evaluate how well they are meeting the demands and norms of the organization. If this feedback signals they have not yet mastered the behavioral expectations, it will encourage further adaptation and refinement of the identity to improve fit (Ibarra, 1999). Internal feedback is also important to this process as people assess their affective reactions to their own behavior and their provisional selves. Critical to this evaluation is whether the individual feels there is congruence between their behavior and the type of person they feel they are or want to be (Ibarra, 1999).

A lack of alignment between how one sees themselves and the behavior they engage in poses a threat to their identity. If a lack of alignment is discovered during a career transition, it can create tension for the individual as they want to be accepted by the group, but also want to be authentic and true to who they are (Ibarra & Petriglieri, 2010). If the provisional self, or the person they feel they would have to become in order to be accepted in a group, is too discrepant from their self-

concept, it may lead the person to leave the organization as the job is not worth compromising who they are and what is important to them.

**Barriers to professional identity development.** The above discussion on professional identity development considers the general influences for most individuals, specifically focused on the research on this process within engineering, but does not fully explore the process for those whose identity development may be impeded by their minority status. The strong culture of engineering and the extreme gender gap makes the consideration of minorities critical to understanding identity in this population. Engineering is considered a gendered occupation meaning that members of one gender are seen as more appropriate for the role than the other based on gender stereotypes (Hatmaker, 2013; Faulkner, 2009a; 2009b). In the case of engineering, men are seen as the appropriate gender, and thus, women are seen as anomalies and often report being stigmatized for their decision to enter the field. Individuals who violate gendered expectations such as these will receive pressure to conform, likely both in and outside of work. Within the workplace, women's low representation makes their gender stand out as they automatically do not fit the prototype of an engineer. Men who do not like the culture of engineering or who do not behave consistently with the field's norms may also be at risk for challenges in identity formation and belonging.

When people engage in behavior that is inconsistent with their gender, they encounter resistance from those around them (Heppner & Fu, 2011). Gender socialization begins at a young age and teaches children what is acceptable for their gender (Heppner & Fu, 2011; Brown & Lent, 2013). Behaviors and activities that are considered gender-appropriate are reinforced (Heppner & Fu, 2011), and as a result, individuals tend to develop skills and engage in activities that are considered gender-appropriate. Women report encountering resistance in the engineering workplace (Faulkner, 2009b; Hatmaker, 2013) as well as outside engineering, in their personal lives.

It appears that women in this field are accustomed to being questioned about their decision to be an engineer as they recite rehearsed stories of why they went into engineering (Faulkner, 2007; 2009b). These rehearsed accounts were not seen in men, however, because engineering is gender-consistent for them and therefore, they are less likely to be questioned about their choice or feel the need to justify their decision. The fact that women tend to offer rehearsed explanations for their choice seems to indicate they feel they have to justify their decision to become an engineer to others, and possibly even to themselves. Each time a woman is asked this question and has to explain her choice, she is reminded that she is different and does not fit (Faulkner, 2009b). The frequency of this type of questioning throughout one's education and career may cause women to question whether they belong and ask themselves whether they should be in this field at all. For men, whose membership in this field is gender-consistent, the question of why they wanted to be an engineer is asked less frequently, if ever, and as a result, their identity as an engineer is likely called into question less often than occurs for women.

Research on stigmatized groups, such as women who enter male-dominated professions, shows their identities tend to be reduced to single-dimensions (Prasad, D'Abate, & Prasad, 2007). Evidence of this type of one-dimensional identity has been found in engineering where women face what Faulkner (2009b) terms 'the in/visibility paradox' where they are "simultaneously highly visible as women yet invisible as engineers" (p. 172). Thus, women in engineering are not seen as engineers, but as women. As a result of this paradox, women say they have to consistently establish and reestablish their engineering credentials to prove their competence, something their male colleagues, whose competence is assumed, do not have to engage in (Faulkner, 2007). Twenty-six percent of women engineers report they feel they are viewed as "intrinsically less capable" (Hewlett et al., 2008, p. 9) than male engineers and have to work to overcome this perception. This type of

marginalization likely makes it more difficult for women to feel a sense of belonging and see themselves as engineers.

Women also struggle with identity issues as a result of everyday interactions in their organizations. Hatmaker (2013) found that for women, many workplace interactions overemphasize their gender while at the same time marginalize their professional identity. In these types of interactions, women tend to be cast into stereotypical roles or are assumed to have skills associated with their gender. For example, a stereotype seen in engineering is that one is either technical or social, but cannot be both. As a result of the culture of engineering, which paints men as technical, women are assumed to be social, and therefore not technical (Faulkner, 2007). This type of dualism is problematic as women are automatically not associated with one of the most critical components of the engineering culture, despite their actual skills and abilities. This creates problems for women as regardless of how technical one is, if others do not see her as an engineer, it will likely make it harder for her to see herself as part of this group and identify as an engineer.

Issues related to belonging may also hinder identity development in stigmatized groups by making them question their fit. Belonging uncertainty is found in members of stigmatized groups in which they express greater uncertainty in regards to their social bonds and heightened sensitivity to matters of belonging (Walton & Cohen, 2007). Belonging uncertainty is typically triggered by an event “that implies a lack of social connectedness” (Walton & Cohen, 2007, p. 2) in which people worry their identity as a minority may lead to negative treatment (Cohen & Garcia, 2008). Once belonging uncertainty is activated, the individual thinks “people like me do not belong here” (Walton & Cohen, 2007, p. 83) and will become vigilant looking for evidence that confirms this hypothesis. When they are in this state, the individual is more likely to notice threatening cues. If a threat is perceived, an individual will assess their ability and desire to deal with the threat, and if they determine they can overcome it and want to, it increases their motivation to achieve and sustains or



improves performance (Cohen & Garcia, 2008). If, however, an individual feels they cannot overcome the threat or lacks the desire to do so, motivation will be negatively impacted and performance will decrease.

Walton and Cohen (2007) found that when belonging uncertainty was triggered in minority students towards their academic major, it not only decreased their motivation to persist in that field, it also made them discourage others in their minority group from entering the field. This likely occurs in engineering as well, as over time, the feeling that “people like me don’t belong here” must wear on an individual and get to the point where they no longer have the desire to fight, encouraging them to leave to find fit and belonging elsewhere. An experience like this would also likely encourage the individual to warn and discourage others like them from entering the field to spare them the negative experience they encountered. Thus, the poor experiences of minorities may prevent others from entering the field, maintaining low numbers of these individuals and preventing them from improving their representation.

Belonging uncertainty in minority groups within engineering is likely a barrier that influences their ability to identify with other engineers and the profession. Belonging is known to be a significant issue for women in engineering and a factor in their attrition from the field. According to Hewlett et al. (2008), 44% of women in engineering report feeling extremely isolated. Isolation is problematic as it creates a difficult environment for the individual and leads to job dissatisfaction and a 22% increase in turnover in this population (Hewlett et al., 2008). Women experiencing isolation at work are likely to feel they do not belong, which calls their identity and career choices into question on a regular basis.

### **Cognitive Dissonance Theory**

A discrepancy between the way one views themselves and their behavior can be distressing as individuals strive for consistency in their thoughts and beliefs. Cognitive dissonance theory

explains this tension and explicates how people make sense out of their environment and behavior (Aronson, 1999). According to cognitive dissonance theory, people strive for consistency between their cognitions (Festinger, 1957; 1962), which Festinger (1962) defines as “any knowledge, opinion, or belief about the environment, about oneself, or about one’s behavior” (p. 3). Dissonance between cognitions results in psychological discomfort, which motivates the individual to engage in activities to reduce this tension (Elliot & Devine, 1994; Festinger, 1957; 1962). When one’s behavior is inconsistent with their sense of self, it threatens their self-concept (Aronson, 1999; Festinger, 1957; 1962) which motivates them to bring their cognitions into alignment in order to reduce the discomfort. This can be achieved by rationalizing the decision, changing the attitude, or changing the behavior, as well as adding new information to the cognitive elements to reduce dissonance (Elliot & Devine, 1994; Festinger, 1962).

Not all dissonance is equally distressing. The level of distress caused by the dissonance is related to the importance or value of the cognitive elements involved, as well as the number of elements that are discordant (Aronson, 1999; Festinger, 1962). Larger numbers of discordant elements that are important to the individual will create greater distress for the individual than fewer elements that are not as central to their sense of self. The magnitude of the dissonance affects the pressure felt to reduce it, with greater levels of dissonance motivating more action to resolve it and greater avoidance of situations where the dissonance occurs. People have different levels of tolerance for dissonance. For some, dissonance is much more distressing than it is for others (Cialdini, Trost, & Newsom, 1995). While some will be motivated to completely avoid an environment that triggers dissonance, others can operate fairly effectively despite the presence of dissonance.

Another factor that influences the level of distress an individual will feel when they experience cognitive dissonance, is how important it is to them to express themselves authentically

(Pugh, Groth, & Hennig-Thurau, 2011). Authenticity is defined by Kernis and Goldman (2006) as “the unobstructed operation of one’s true or core self in one’s daily enterprise” (p. 294). Those who are able to behave authentically experience many positive outcomes including increased levels of global self-esteem, greater alignment in their identities, and adaptive use of coping styles (Kernis & Goldman, 2006).

In situations where one is expected to behave in a specific manner, regardless of their true emotions, they engage in emotional labor to display the prescribed emotions (Hochschild, 1983). Behaving in a manner inconsistent with one’s emotions can be stressful because of the dissonance it causes even in those who do not place a high value on emotional authenticity. Emotional labor is depleting to the individual as the acting involved in this process requires resources (Grandey, 2000) which can lead to emotional exhaustion and poor job satisfaction (Grandey, 2003; Pugh et al., 2011). Those who feel the need to behave in ways that are contrary to their self-concept can become burned out as a result of the effort involved in emotional labor, with those who value authenticity experiencing more negative consequences (Pugh et al., 2011).

The issue of dissonance is relevant to minority populations within engineering as it offers an explanation for why many choose to leave the field. For example, it may be that engineers who leave have a higher level of intolerance for dissonance or determine they would have to change too much to stay that it is not worth it. The internal struggle between who they are expected to be as an engineer and their self-concept may be so distressing that the only way they can reduce the dissonance is to leave the field altogether. Those who stay may still feel dissonance in their identity but are able to deal with the discrepancy between their self-concept and the environment by making modifications. These adaptations could include increasing one’s level of identity with other engineers, taking on some of their views, or acting and dressing in similar ways, which make them feel more like they belong.

Adaptations such as these have been reported by women who have stayed in engineering and are likely a means of making it easier for themselves and others to see them as engineers. Those who stay in the field are more likely to discuss ways they adapted to the culture of engineering than those who left, who tend to blame their departure on the culture (Ayre, Mills, & Gill, 2013; Buse, 2009; Buse et al., 2013; Fouad & Singh, 2011; Hewlett et al., 2008). Persisters in Buse (2009) acknowledged a need for creativity in navigating the environment and made changes that enabled them to feel a sense of belonging. A common theme seen in women is that they deny or distance themselves from their identity as a female by acting and looking less feminine. Sixty-three percent of female engineers report changing how they dress to a more gender-neutral or masculine style (Hewlett et al., 2008) to be seen as an engineer. These women felt changing their appearance and wearing more masculine clothes helped increase the perceived similarity between themselves and their male colleagues because they looked more like them. Others look down on or avoid other women (Buse, 2009; Hewlett et al., 2008; Fouad & Singh, 2011), possibly to show they are rejecting this group to improve their chances of being seen as a member of the male in-group. Women who adapt to the culture of engineering by downplaying their gender may be able to reduce the salience of their identity as a woman, and instead, make their identity as an engineer more salient, improving their odds of being accepted. These types of adaptations may also help a woman see greater similarity between herself and those she works with, facilitating her identification with engineers and her desire to stay in the field.

Women in male-dominated, gendered professions, as well as men who do not fit the norms of this group, likely find it more difficult to feel a sense of belonging and identify with the group than majority members. As a result, they likely have to make more adaptations to be accepted, and behave in ways inconsistent with their self-concept, which can be exhausting and lead to burnout. These individuals may reach a point where they feel it is simply not worth the constant battle of

having to prove themselves, so they make the decision to leave even though they enjoy engineering work.

A mixed methods approach was used in this investigation to provide a deeper analysis on professional identity and retention of women in engineering, as well as an exploration of these factors in men.

### **Research Questions**

1. What is the correlation between professional identity and persistence in the field of engineering?
2. Is there a gender difference in the level of professional identity reported by male and female engineers?
3. Within each gender, is there a difference in the level of professional identity reported by those who have stayed in the field and those who have left?
4. What factors encourage people to persist or leaving the field of engineering?
5. What is the role of professional identity on retention in the field of engineering?

## CHAPTER II

### Method

This investigation utilized archival data from a previously conducted mixed methods research study on the experiences of individuals who have earned engineering degrees. Information will be presented first on the original study to provide an overview of how the data was collected. This will be followed by a section discussing the present investigation.

#### Original Study

Data for the investigation was collected through surveys, interviews, and work history forms. While all participants took the survey, only those who met specific selection criteria were interviewed and asked to fill out work history forms. The survey evaluated a variety of factors including demographics, religion, and professional identity. The purpose of the interviews was to learn about the experiences of the participants both in college and in the workforce, and to investigate the factors that influenced them to stay in or leave the field of engineering. Those who were interviewed were asked to fill out a work history form to provide a record of their career since graduation.

**Participants.** A snowball sampling method was used to recruit participants. One recruitment method was an email sent to engineering alumni at the three universities where the Principal Investigators (PIs) work. The recruitment email was sent to all engineering alumni at two of the schools, and only to women engineering alumni at the third. The email explained that individuals were being recruited for participation in a survey and included the link to the survey, which was taken online. Those who had earned an engineering degree were invited to participate regardless of whether they were currently working in engineering or not. The email requested that people pass the survey link along to others they know who have degrees in engineering, especially women. Announcements about the survey were also placed in a regional Institute of Electrical and

Electronics Engineers (IEEE) newsletter as well as a regional Society of Women Engineers (SWE) newsletter. Finally, due to the interest in religion in the original study, a notice was placed in a few church bulletins to recruit participants. A total of 1,055 people participated in the survey.

One of the purposes of the survey was to select individuals for inclusion in interviews. Those who indicated on the survey that they were willing to participate in an interview were considered for major, gender, engineering field persistence, identity score, years since graduation, and religion. Women were purposely oversampled as they were the population of greatest interest to the PIs. Individuals were selected such that within each gender there were a range of identity scores, as well as people who had left engineering and those who continued to work in the field. In addition, a number of persisters with low identity scores on the survey, and a number of non-persisters with high identity scores were selected to more closely examine the stories of these individuals. Only individuals who earned degrees in the most common engineering disciplines were selected originally, which included electrical engineering, computer engineering, mechanical engineering and civil/environmental engineering. However, a few participants with other majors were included because they had other characteristics of interest (i.e., gender, persistence, identity, or religion), to provide a sufficient sample of each type. Several individuals who identified themselves as Christians and met the above criteria were also selected for participation although religious affiliation will not be considered in the current investigation.

Surveys were taken online by participants using the web address provided in the recruitment emails, newsletters, and bulletins. No payment was given for participation in the survey. For the interviews, about half were conducted in person at a mutually convenient location, such as a coffee shop, and the rest were done over the phone due to distance between the location of the interviewer and the participant. Those who participated in an interview were given a gift card to Amazon.com to thank them for their time. Initially, participants were given a \$20 gift card but when more agreed

to participate than initially anticipated, the value had to be reduced to \$10 to ensure all who took part in an interview could be given a gift card. IRB approval was received at each of the three schools involved in the investigation and efforts were taken to ensure all procedures were ethical and did not cause harm to the participants.

### **Measures and covariates.**

**Professional identity.** Professional identity was evaluated using one of the scales from the survey administered to participants. The scale consists of four items adapted from Chachra et al.'s (2008) Group Identification Scale which measures four dimensions of professional identity including centrality, private regard, public regard and group identification. Chachra et al. (2008) adapted their measures of centrality, private regard and public regard from the Multidimensional Inventory of Black Identity (MIBI; Sellers, Rowley, Chavous, Shelton, & Smith, 1997; Sellers, Smith, Shelton, Rowley, & Chavous, 1998). These items on the MIBI were derived from the Multidimensional Model of Racial Identity (MMRI; Sellers et al., 1997; 1998) which is an inventory that “focuses on African Americans' beliefs regarding the significance of race in (a) how they define themselves and (b) the qualitative meanings that they ascribe to membership in that racial group” (Sellers et al., 1997, p. 806). Centrality in this study is defined as the extent to which an individual defines himself or herself as an engineer. The two dimensions that pertain to regard capture the level of positivity in one's evaluations of a group they belong to (Seller et al., 1998). Private regard refers to how positively or negatively an individual feels about engineering and engineers, whereas public regard reflects one's perceptions of how positively or negatively others view engineers. Chachra et al. (2008) did not provide any psychometric information on their scale but reliability was high for the MMRI and MIBI scales: centrality ( $\alpha = .77$ ), private ( $\alpha = .78$ ) and public regard ( $\alpha = .78$ ; Sellers et al., 1997; 1998).



The fourth dimension of Chachra et al.'s (2008) scale was adapted from Hinkle, Taylor, Fox-Cardamone, and Crook's (1989) group identification scale by the same title. Several of the items from Hinkle et al.'s (1989) scale, including the one used in this investigation, were adapted from Brown, Condor, Mathews, Wade, and Williams (1986). Group identification is defined as "the value individuals place on being an engineer and the emotional-affective dimensions of belonging to this group" (Chachra et al., 2008, p. 4). Internal reliability was found to be high on Brown et al.'s (1986) scale with an alpha of .71.

Professional identity was measured on a four-item scale, with one item evaluating each of the four dimensions described above. The different dimensions through which this scale evaluates identity is valuable as it considers the construct from different angles to provide a more holistic view of professional identity in engineers. The four items included in the scale are: "Being an engineer is an important reflection of who I am," "I feel strong ties to engineers," "I am proud to be an engineer," and "Society views engineers as an asset." Participants were asked to indicate the degree to which they felt each statement was true for them on a scale of 1 (*not at all*) to 5 (*very true*). The scores on each of the four items were summed to create an overall professional identity score for each participant. See Appendix A for the professional identity scale.

**Work experience.** Participant's work experience since college was evaluated on the survey by a single item with four response options. Participants were asked to select the response that best describes their work experience since graduating, selecting from: (a) I am presently working as an engineer or seeking to work as an engineer, (b) I am currently choosing not to work as an engineer, but I did work as an engineer for some period of time since graduating, (c) I have not worked as an engineer since graduating, but I have previously sought engineering employment, (d) I have not worked as an engineer since graduating, and I have not sought engineering employment. Those who selected the first option, indicating they were currently working as an engineer or seeking

engineering work, are referred to in this investigation as persisters. Individuals who selected any of the other three options are referred to as non-persisters as they are not working as engineers.

**Interviews.** A narrative approach to measuring identity was chosen due to the research evidence supporting its value in evaluating this construct (Haußer, 2007). Identity narratives are the stories individuals create to construct meanings attached to the self (Conroy & O'Leary-Kelly, 2014; Ibarra & Barbulescu, 2010), the analysis of which can elucidate the individual's sense of identity and how it was created. The interview questions included in the semi-structured interview consisted of open-ended questions designed to elicit identity narratives. The question asking why the participant decided to pursue engineering was adapted from Haußer's Flensburg Identity Status Interview (2007) which was adapted from Marcia's Identity Status Interview (Haußer, 2007).

**Work history form.** The work history form was created to collect data on interview participants' educational and work history. The form was a single page that individuals were asked to fill out prior to the interview. The section on educational history asked participants to report the name of the institution, the discipline, and the year they earned each of their degrees. The work history portion asked participants to list each of their jobs including the employer, job title, dates worked, whether the job was full- or part-time, and whether it was an engineering job.

**Procedure.** Participants received a link to the online survey through an email, newsletter, or bulletin. All participants first took the online screening survey, which included items measuring demographics, professional identity, and religious participation. When they visited the web address they saw a page that briefly introduced the study and explained they had to give informed consent before taking the survey. The next page contained the consent form, which they were asked to read and then select the option indicating whether or not they agreed to participate in the survey. If they selected the option saying they did not consent, they were exited from the survey and thanked for

their time. Those who did consent to participate were taken to the survey, which took about 10 minutes to complete.

At the end of the survey participants were asked to provide their contact information if they were willing to be contacted at a later date for a follow up. Those who provided their contact information were considered for inclusion in the follow-up interviews by the researchers. Those who agreed to be contacted and met the criteria for an interview were emailed by a researcher or research assistant (RA) asking if they were still interested and willing to participate. Those who responded to the email saying they would participate were contacted by a researcher or RA to set up a time and date for the interview. At this time, the individual was informed they would be emailed a work history form which they were asked to fill out before arriving for the interview. They were also told they could submit a resume instead of filling out the form if they preferred. Those who were scheduled to participate in a phone interview were also emailed the consent form and asked to return it prior to the interview.

Prior to beginning the interview, the researcher explained the consent form and had the participant sign it if they had not signed and returned it already, as in the case of the phone interviews. They also asked the participant if they were willing to be audio recorded. If the participant agreed, the interview was recorded and then transcribed verbatim by a RA. If the participant did not want to be recorded, no recording was made and instead the researcher took extensive field notes to capture the conversation.

Work history forms were collected prior to the interview from those who had completed them. Those who did not fill out the form were told they could finish it at the conclusion of the interview. In instances where this occurred and the interviewee did not have the time to stay and complete the form, they were told they could take it with them and were provided a stamped envelope with the mailing address of the researcher so they could return it when finished. Those

who took the form home to complete rarely returned it so work history is not available for all interview participants.

### **Present Investigation**

The present investigation utilized archival data from the mixed methods study described above. A mixed methods approach was used in this investigation due to the variables evaluated, the goals of the study, and the author's orienting perspective. One of the benefits of using a mixed methods approach, which combines both qualitative and quantitative data within a single study, is the ability to capitalize on the strengths of each method and minimize the weaknesses (Johnson & Onvmegbuzie, 2004). Ongoing debate has existed concerning whether quantitative and qualitative methods can be combined due to "differences between their underlying paradigm assumptions" (Denzin & Giardina, 2015, p. 13). The author, however, assumes a pragmatist perspective which is "not committed to any one system of philosophy and reality" (Creswell, 2014, p. 11) and encourages selection of the research methods that best evaluate the research question (Johnson & Onvmegbuzie, 2004). Consistent with Ormston, Spencer, Barnard, and Snape (2013), the author sees quantitative and qualitative methods as complementary, rather than contradictory, and believes combining the two is the best approach for the present investigation based on the purpose of the study and the research questions.

Due to the use of different methods, mixed methods research allows for a deeper level of analysis and enriches results (Creswell, 2014; Hanson, Creswell, & Clark, 2005; Tashakkori & Teddlie, 2003), in addition to mitigating common method variance (Campbell & Fiske, 1959; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). By pairing the quantitative ratings of professional identity with the thick, rich descriptions characteristic of qualitative data (Denzin & Lincoln, 2008), a more comprehensive understanding of professional identity can be gained than with either method alone (Hanson et al., 2005).

Qualitative research is valuable for exploring “the depth and complexity of human experience” (Morrow, 2007) as it provides a deeper level of analysis than can be achieved with quantitative methods. Furthermore, qualitative research is focused on “*how* social experience is created and given meaning” (Denzin & Lincoln, 2008, p. 14). Due to the depth of exploration, this approach is effective in situations where there is little previous research available on a topic (Morrow, 2007), as is the case for both professional identity and retention in the engineering workforce. Qualitative data is important in this study in order to understand the identities and experiences of engineers and how those influence their perceptions of engineering and the decisions they make related to persistence in the field. Quantitative data was also important to include in this investigation as no quantitative studies exist on professional identity in engineers.

The data was analyzed using a concurrent triangulation mixed methods design in which quantitative and qualitative data are collected and analyzed at the same time (Hanson et al., 2005). Both types of data were given equal priority and integrated during the data analysis phase (Hanson et al., 2005), with data for men and women analyzed separately to allow for immersion into the stories of each.

QUAN + QUAL



Results

The following information describes the procedures specific to the present study with separate sections for the quantitative and qualitative portions of the investigation.

### **Quantitative analysis.**

***Participants.*** In order to be included in the study, participants must have earned a degree in engineering. Those who reported a non-engineering degree were not included in the analysis. In addition, those who said they had not worked in engineering after earning their degree were also

excluded from the survey in order to focus on professional identity in those who had engineering workplace experience. The two participants who did not report their gender were also excluded due to the focus on gender in this investigation. After accounting for missing data and outliers, 891 of 1,055 individuals met the criteria for inclusion. Gender within this sample was reported as 53.6% female and 46.4% male. Ethnicity was reported as 83.1% Caucasian, 8.8% Asian or Pacific Islander, 2.9% mixed or multiple ethnicities, 1.7% Black or African American, 1.0% Hispanic or Latino, 0.5% American Indian or other Native American, and 2.9% did not indicate their ethnicity. Table 1 displays the engineering subdisciplines participants reported earning their degrees in, as well as the percentage who reported each subdiscipline.

Table 1

*Subdiscipline of Engineering Degree as a Percentage of the Sample*

Engineering Subdiscipline	Percentage of Participants (%)
Electrical/Computer	36.4
Mechanical	22.7
Civil/Environmental	19.2
Chemical	8.2
Material science	4.2
Aerospace/Aeronautical	4.0
Industrial	2.5
Double major (both engineering) <sup>a</sup>	1.1
Other engineering subdiscipline	0.9
Biomedical	0.7
No subdiscipline reported <sup>b</sup>	0.2

<sup>a</sup>Participants who listed more than one subdiscipline other than electrical and computer engineering.

<sup>b</sup>Subdiscipline was listed as general engineering.

**Power.** A power analysis conducted using the program G\*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007) recommended a sample size of 128, with 64 participants in each group, to sufficiently power two-tailed independent samples *t*-tests comparing identity levels in men and women, as well as professional identity within gender. Most work in this area has been measured

qualitatively so an effect size could not be found in the literature. Therefore a medium effect size of  $d = .5$  was estimated, with alpha and  $1-\beta$  levels set to .05 and .80, respectively. A power analysis was also conducted for a point-biserial correlation, which tested for the relationship between persistence in the field and level of professional identity. No previous work on this relationship could be found and thus a medium effect size ( $p = .3$ ) was estimated for this analysis as well. Alpha and  $1-\beta$  levels were set to .05 and .80, respectively, for a two-tailed test. The power analysis indicated that a total sample size of 82 was needed to sufficiently power this test. The size of the sample collected through the survey sufficiently powered all quantitative analyses.

#### **Measures and covariates.**

**Professional identity.** The construct of professional identity is defined in this investigation as “one’s professional self-concept based on attributes, beliefs, values, motives, and experiences” (Slay & Smith, 2011, p. 85). Professional identity was evaluated using the four-item survey scale described above. An overall professional identity score was created for each participant by summing their scores on each of the four items. While the items on the professional identity scale were derived from measures which evaluate identity in terms of race, the fact they assess identity by looking at one’s self-concept and the meaning of group membership make these a good fit for this investigation, as these same aspects of identity were evaluated, but within the context of engineering.

Analyses of the professional identity scale indicated the public regard item was weakly correlated with the other scale items and that alpha would improve if the item were removed. Therefore, public regard was removed from the professional identity scale, resulting in a three-item scale with an alpha of .811. With the three-item scale, the minimum professional identity score possible was three and the maximum score was 15.

***Work experience.*** Work experience since college was evaluated on the survey by a single item with four response options. Participants were asked to select the response that best describes their work experience since graduation.

### **Qualitative analysis.**

***Participants.*** A total of 61 interviews were analyzed and coded in this analysis. Interview transcripts were randomly selected within each group (i.e., male persister, male non-persisters, female persisters, and female non-persisters) from the larger pool of interviews collected in the original study. Additional transcripts from each of the four groups were read and coded until either all available transcripts for the group had been coded or no new themes emerged. Of the 61 interview participants randomly selected in the present investigation, 24 were men and 37 were women. This sample included 14 male persisters, 10 male non-persisters, 24 female persisters and 13 female non-persisters. All participants graduated between 1973 and 2010.

### **Measures and covariates.**

***Interviews.*** In order to learn about the experiences of the participants and their sense of professional identity, interview transcripts and field notes were analyzed. Qualitative data was analyzed using a grounded theory approach in which theory is generated inductively (Haig, 1995; Strauss & Corbin, 1990). According to Strauss and Corbin (1990), the purpose of grounded theory is “to build theory that is faithful to and illuminates the area under study” (p. 24). A grounded theory approach is appropriate for this investigation as it allows for the exploration of variables that have not been well studied, as well as the generation of theory (Creswell, Hanson, & Clark, 2007; Fassinger, 2005). The dearth of professional identity exploration within the engineering profession makes grounded theory a valuable approach for the present study as there is little theory in existence about the relationship between professional identity and engineering retention, especially for men.



The grounded theory analysis of the interview transcripts began with initial coding in which transcripts were read and provisional codes were assigned to themes that emerged (Charmaz, 2014). This was followed by several additional rounds of increasingly focused coding during which the codes were reviewed and refined (Corbin & Strauss, 2014) to improve their representation of the data (Charmaz, 2014). Throughout this process constant comparison was used to compare data within a participant's transcript, as well as between codes and between participants, to enable connections to be made and theory to be built (Corbin & Strauss, 2014). Constant comparison was also used to ensure the codes were accurate and that important themes in the data were represented (Fassinger, 2005; Haig, 1995; Strauss & Corbin, 1990).

***Trustworthiness.*** The trustworthiness of qualitative work is assessed differently than in quantitative work, and therefore, criteria for establishing the credibility of qualitative research were utilized. In accordance with Gephart's (2004) criteria, the literature review includes a comprehensive discussion of all variables included in the analysis as well as relevant past research. The goals, objectives, and research questions are all explicitly stated, and all relevant constructs are defined. In addition, the methodology of the study was thoroughly explained so that readers are clear as to how methods were selected considering the author's views regarding philosophy of science (Ponterotto, 2005), as well as how codes and themes were created (Gephart, 2004). Furthermore, the discussion section includes an in-depth narrative which explains the findings and provides context for the analysis.

According to Gephart (2004), qualitative research should be embedded in a larger research program, which this investigation is. The present investigation uses archival data from a study on degreed engineers and expands upon the findings of this work to further knowledge about this population. In accordance with Gephart (2004), Morrow (2005) stresses the importance of adequacy of data for establishing trustworthiness in qualitative research. This was accomplished

through purposeful sampling in the original study and the use of multiple data sources. Another aspect of trustworthiness in qualitative research is adequacy of interpretation (Morrow, 2005). In order to meet this objective, the author immersed herself in the data and thoroughly read and coded each interview transcript, or set of field notes, multiple times to ensure all important aspects were noted. In addition, analytic memos (Corbin & Strauss, 2014; Strauss & Corbin, 1990) and notes were also kept throughout the study to provide a record of the author's thoughts and the themes that emerged from the data.

## CHAPTER III

### Results

#### Missing Data

The dataset was evaluated for missing data and all participants who were missing scores on more than 24% of the items were removed from the dataset (Olinsky, Chen, & Harlow, 2003). Data for the remaining participants included no missing data as all items analyzed in this investigation were required on the survey. As a result, complete data was available for all 898 participants and no measures had to be taken to correct for missing data.

#### Outliers

Data screening was conducted to assess whether there were outliers present in the data. Visual inspection of histograms indicated there were potential outliers needing to be investigated further. Professional identity scores were standardized to look for cases with extreme  $z$  scores greater than 3.29 ( $p < .001$  [Tabachnick & Fidell, 2013]). Four cases were removed from the dataset because they were found to have  $z$  scores greater than 3.29 and were clear outliers on boxplots. Three additional participants were removed whose professional identity scores were outliers on the boxplots. The remaining dataset contained a total of 891 participants.

#### Statistical Assumptions

Prior to conducting analyses, the statistical assumptions of the two tests to be calculated were evaluated. Since this investigation uses grouped data, professional identity was assessed within men, women, persisters, and non-persisters (Tabachnick & Fidell, 2013). Normality was evaluated visually due to the sensitivity of significance tests of skew and kurtosis, as well as tests of normality, to large sample sizes (Field, 2013). Histograms and Q-Q plots were assessed visually for evidence of deviation from normality. The points on the Q-Q plots for professional identity for both genders and persisters versus non-persisters, fell close to the line indicating a fairly normal distribution. The

histograms for both genders and both work experience groups showed a positive skew with a greater number of scores on the right sides of the distributions. Consideration was also given to the values of skewness and kurtosis, all of which were close to zero which is an indication the data is fairly normally distributed (Field, 2013). Skewness values were negative for all four groups which indicates there is a greater concentration of high scores than low scores, which was also seen in the histograms. Kurtosis for all groups, except the persisters, was negative indicating the distributions are flat and have light tails (Field, 2013). Since the assumption of normality was likely violated, a decision was made to use bootstrapping when analyzing professional identity by gender and by persistence, which allows for the calculation of unbiased confidence intervals and significance tests (Field, 2013).

The data was evaluated for homogeneity of variance through the use of statistical tests and boxplots. Levene's test for professional identity within gender was significant, indicating the assumption of equal variances was violated. Levene's test can be affected by large sample sizes so the variance ratio (Hartley's  $F_{\max}$ ) was also calculated (Field, 2013), which also indicated a violation of the assumption. Boxplots were utilized to assess the distribution of professional identity scores within each gender. Visual examination of the boxplots showed there was similar variability in the distribution of scores for women and men. Homogeneity of variance was also assessed for the two work experience groups using Levene's test and the variance ratio. Both tests indicated the assumption had been violated and boxplots showed differences in variance between the two work experience groups. Due to the lack of options for dealing with this violation no correction will be made, and thus, results should be interpreted with caution.

Descriptive statistics for professional identity for each gender and work experience group (i.e., persisters and non-persisters) can be found in Table 2.

Table 2

*Descriptive Statistics for Professional Identity by Participant Group*

Participant Group	<i>M</i>	<i>SD</i>	Min.	Max.
Men	12.47	2.16	6.00	15.00
Women	12.25	2.39	6.00	15.00
Persisters	12.55	2.13	6.00	15.00
Non-Persisters	11.82	2.58	6.00	15.00

**Quantitative Analyses**

**Point-biserial correlation.** The first research question was evaluated using a point-biserial correlation to assess the relationship between professional identity and persistence in the field of engineering. Professional identity was significantly correlated with persistence in the field  $r_{pb} = .142$ ,  $p < .001$ , indicating that professional identity accounts for 2.0% of the variability in persistence. The 95% confidence interval ranged from  $-.209$  to  $-.076$ . Those who persisted in the field ( $M = 12.55$ ,  $SD = 2.13$ ) scored higher on professional identity than those who left ( $M = 11.82$ ,  $SD = 2.58$ ).

Figure 1 illustrates the concentration of professional identity scores for persisters at the high end of the scale compared to non-persisters whose scores were more evenly distributed.

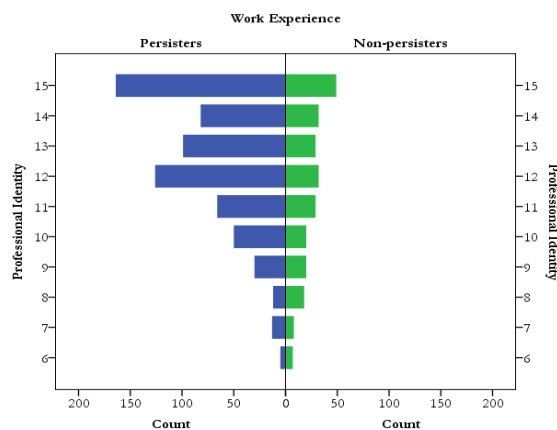


Figure 1. Histogram of professional identity scores for persisters compared to non-persisters.

**Independent samples t-tests.** An independent samples *t*-test was conducted to evaluate the second research question which asked whether there is a gender difference in professional identity. The results of the *t*-test indicated there was not a statistically significant difference  $t(886.95)$

= -1.448,  $p = .148$ ,  $d = .10$ , between the means of professional identity for men and women, however men ( $M = 12.47$ ,  $SD = 2.16$ ) scored slightly higher on professional identity than women ( $M = 12.25$ ,  $SD = 2.39$ ). The bootstrapped 95% confidence interval for the difference in means was small, ranging from -.52 to 0.09. Since this confidence interval includes zero, there is a possibility that no effect exists.

Additional independent samples  $t$ -tests were conducted for the third research question to evaluate whether there is a difference in professional identity for persisters versus non-persisters within each gender. The results of the  $t$ -test for men indicated there is a statistically significant difference  $t(101.17) = 1.994$ ,  $p = .045$ ,  $d = .25$  between the means of professional identity for male persisters and male non-persisters, with male persisters ( $M = 12.59$ ,  $SD = 2.03$ ) scoring higher on professional identity than male non-persisters ( $M = 11.96$ ,  $SD = 2.62$ ). The bootstrapped 95% confidence interval for the difference in means was fairly small, ranging from -.016 to 1.248. Since this confidence interval includes zero, there is a possibility that no effect exists. The  $t$ -test for women indicated there is a statistically significant difference  $t(297.28) = 3.168$ ,  $p = .001$ ,  $d = .30$  between the means of professional identity for female persisters and female non-persisters, with female persisters ( $M = 12.51$ ,  $SD = 2.25$ ) scoring higher on professional identity than female non-persisters ( $M = 11.76$ ,  $SD = 2.57$ ). The bootstrapped 95% confidence interval for the difference in means was fairly small, ranging from .303 to 1.217. See Table 3 for means of professional identity by gender and work experience.

Table 3

*Professional Identity Score Means by Gender and Work Experience*

Statistic	Men		Women	
	Persisters	Non-Persisters	Persisters	Non-Persisters
<i>M</i>	12.59	11.96	12.51	11.76
<i>SD</i>	2.03	2.62	2.25	2.57

## Qualitative Analysis

The purpose of the qualitative analysis was to examine the experiences of both men and women with engineering degrees to better understand the factors that cause them to stay in or leave the field of engineering, as well as to evaluate the role of identity in these populations. The themes identified in the interviews are described below along with quotes from participants. All participants were assigned a pseudonym which was used instead of their name to protect confidentiality. Themes are discussed in descending order of the number of participants in each group who discussed the topic, from most to least common for each group. Males will be discussed first, followed by females. In response to research question 4, the reasons persisters listed for staying in the field will be presented. Next, the reasons persisters have considered leaving will be discussed, followed by the factors that have caused non-persisters to leave the field. A section on identity will also be presented for each gender in partial response to research question 5, which will be addressed fully in the discussion section where the quantitative and qualitative data, as well as the themes across groups, will be integrated.

Many of the participants listed more than one factor related to their retention or identity, and thus, several participants appear in multiple categories. In addition, not all participants discussed every topic as some opted not to respond to particular questions, and occasionally the interviewers omitted questions they felt were not relevant to the conversation. The number of participants within a particular category who did discuss the topic, as well as the number of participants in that group overall, will be listed at the beginning of each section.

### **Male persisters.**

***Reasons to stay.*** Eleven of the 14 male persisters discussed their reasons for staying in the field of engineering.

*Enjoyment of engineering work.* Five of the men who have stayed in engineering say they are still in the field because they enjoy the work and the types of projects they do. Several of them talked about how they are doing things they enjoy and are excited by the projects they work on. For many, engineering has met a variety of their interests and given them opportunities to use their skills, which makes them want to stay. Tony for example said:

My goal is to get to learn more about stuff, get to play around with a bunch of fun stuff and get to like make stuff up. I really just sit around in a chair and dream up circuits to solve problems.

Their love of the type of work they do and the projects they have the opportunity to work on seem to be a factor in male persisters' decisions to stay in the field of engineering.

*Money.* Five of the persisting men cited money as the main reason they have not left engineering. Max, for instance, admitted he was dissatisfied with aspects of his work but does not intend to leave engineering because of what he earns:

I don't know if I'd ever step away from [engineering], especially now because it's the best way to provide for my family financially and I'm at a point where I keep going but there are things that frustrate me enough that I want to change or move in a different direction.

Maybe try a different field- instead of aerospace, maybe go into biomedical or something like that.

Max goes on to say, "the pros outweigh the cons and it's definitely the best way for me to provide for my family. It's given me the ability to make an income so that I can keep my wife at home with the kids." Another man also talked about earning enough for his wife to stay home with their children. For others though, it was simply earning a "consistent paycheck" or being paid well that made it worth staying.



*Good companies and opportunities.* Two of the persisters stated they stayed in engineering because they have good jobs and are with companies that give them opportunities. Andrew said he stays in engineering because he has a “solid job.” When asked what he meant by solid, he replied, “good company to work for, they’re very family-oriented, I enjoy working there, they have a lot of great different jobs, I’m getting lots of experience, I like the people a lot, it’s got great benefits.”

Max is another persisting male who also values the opportunities his company gives him saying:

They advanced me very quickly. They gave me lots of opportunity to prove myself, put me on lots of projects that challenged me.... It was just enough to challenge me, to keep me moving at a quick curve and keep me learning new stuff every day and I continue to have more and more opportunities.

***Reasons to leave.*** Seven of the 14 persisting men reported factors that have made them consider leaving engineering. The remaining seven said they did not want or intend to leave the field.

*Work-life balance.* The most common reason persisting men cited as a factor that makes them consider leaving engineering is the long hours expected of those in this field and its effects on work-life balance, which was discussed by four. Greg talked about a two-month period in his career that was especially demanding of his time after which he felt, “like my life was gone and I’m not getting that back. Am I gonna do this every year or every other year like this just doesn’t make sense.” He went on to talk about what he felt was a “lack of boundary,” and was frustrated by “just how much time that took away from my personal life and from my life outside of work.” Another participant was also bothered by the hours expected of engineers, saying:

Someone once was like, you want to be the best engineer you can be. And I was like screw that because if I’m the best engineer I can be then I’m going to treat my family like crap because I’m never going to ever be around, I won’t have time for people. (Tony)

Andrew said the long work hours in engineering were fine before he had kids, but having kids “centered me on true values in life,” causing him to change his role and set boundaries at work to allow more time for his family. He said he chose to move more to the operations side of the company, which does not require the same long hours as engineering, and he no longer works weekends, unless there is an emergency. In addition, he said, “I don’t stay past 6 anymore.... I’ve got to be home for dinner every night. It’s my own rule.... with kids, I think it’s important to be home every night at the table. Put them to bed.”

According to Juan, a faculty researcher at a university, work-life balance is an issue for engineers in academia as well:

Once you get to the PhD level in research and things you kind of lose especially women but also men who want to try to do a family because once you get up to that level, I mean, there's all the tenure issues and all this other craziness that means you basically can't start to have kids until you're 36 to 40 and I think a lot of people look at that, especially when they're 23 or something, go uh....Hell no.

*Competing interests.* Four male persisters had considered leaving engineering to explore a career interest they felt they could not meet in either their current jobs or the field. These individuals did not dislike engineering, but either had additional career interests they felt might pull them away or were looking for a challenge they were not finding within engineering. Andrew, who has been an engineer for 10 years, found himself enjoying sales and business because it offered him more of a challenge than his job as an engineer. According to Andrew, engineering is:

Good solid work but it’s the same thing every day, to an extent. I still enjoy the challenge, especially what I do. I design all sorts of different things so it’s challenging each day but I find myself wanting to branch out even more.

Andrew went on to say that he likes being challenged in his work and felt pulled to sales and business because it offered more of a challenge. Another participant, Phil has considered “hanging up” the engineering and technical side of himself to pursue something where he can use his people skills.

Greg actually took a leave of absence from his engineering job to live in South America and explore his interest in Spanish. He originally wanted to major in Spanish but opted for engineering because he felt it was a more practical degree with greater earning potential. However, his interest in Spanish continued even after he was working as an engineer so he took the trip to be “immersed in the culture, or in the language” to figure out if that interest was something he should leave engineering to pursue. Upon returning from the South America, Greg felt he had made the right decision choosing engineering but is glad he took the trip to determine whether he should change careers.

*Mismatch in values.* Two persisting men said they would consider leaving engineering to avoid working on military projects due to their beliefs about war. Both of these individuals worked on military projects and pointed out that it can be hard for engineers to avoid working for the military in some capacity, citing two main options for employment in the field:

There’s consumer electronics like your cell phones and PCs and there’s military, and there’s other stuff but those are like the big two regions. And like if you go to grad school you’re probably going to be funded by the military if you go into engineering. If you get a job, you’re probably going to sell to the military because they buy tons of expensive technology so it’s hard to avoid it. (Tony)

Tony commented that the military involvement in his job was “kind of far removed...and I didn’t even- it seemed really far to me when I took this job but it’s still there and I don’t know, I just don’t like it.” Kevin works for a defense contractor but pointed out the company does not make

any lethal weapons and the project he works on actually prevents civilian casualties. He went on to say he would never want to make weapons, and although he felt his job was close to that, it was far enough away that he could live with it.

Kevin also discussed the decision he faced between two job offers he received after graduation; one job would pay more but the company made bombs. He said his faith, spiritual life, and worldview made him choose the lesser paying job to avoid working for a company that produced bombs. He also said he would not do work that exploited third world countries or work for an oil company, unless the job involved alternative fuel sources. For both of these individuals it was clear their personal values were a significant influence on their career choices and may lead them away from the field in the future if their values clash with the work they are asked to do.

#### **Male non-persisters.**

***Reasons for leaving.*** Eight of the 10 non-persisting men discussed their reasons for leaving engineering.

*Competing interests.* Four non-persisting men left engineering because of a change in interests or to pursue an interest outside of engineering. Chris, for instance, had always planned on becoming an Air Force pilot and majored in electrical engineering mainly because it awarded the most scholarship money. After college, he joined the Air Force as planned, and is now a pilot. For Chris, it was not a change in interest that made him leave engineering; it was his desire to become a pilot that outweighed engineering and made him choose the route he did. He did say, however, that he has considered pursuing an engineering job after he fulfills his commitment to the Air Force.

Ryan and Isaac both left the field due to a change in their interests. During college, Isaac found that he liked non-profit work and serving others, which he felt he could not fulfill in engineering. Ryan, in contrast, left engineering during his PhD studies as he felt he was being called

to become a Catholic priest. Ryan claims, “It was not so much that I lost excitement for engineering/physics but that I found something that I was that much more passionate about.”

*Career development.* Four of the non-persisters said they left engineering to progress in their careers or to find better opportunities. Three of these men chose to pursue management roles within companies that did engineering work. In order to help him move from an engineering role into management, Mark chose to enter a master’s degree program in engineering management.

When asked about his decision to leave engineering to pursue the degree, Mark said:

It was really an element of my own chosen career progression. I knew I didn’t want to be a design engineer for my entire working career. In my own mind I guess I had this, I wanted to have a good solid foundation, to prove that I can do the electrical engineering that I was trained to do and then work towards the management career path as opposed to the senior technical career path. So this degree was really a step for me working into the management of work teams and work groups...so it really did help me to achieve, attain for me moving from a design engineer and an individual contributor to that of a team lead and an engineering manager and engineering director.

Bill also pursued an advanced degree to help him transition into a management role and planned to continue working in an engineering firm. Brad attributed his move into management to the lack of control engineers have over their projects and felt he would have more control and stability as a manager.

In contrast to the three men who left traditional engineering jobs for management positions, the lack of opportunities available in Henry’s company encouraged him to leave engineering. Henry did not feel there was room for growth in his company and seemed unable to get assigned to the projects he was interested in. As a result, he felt the need to leave to find the types of opportunities he was looking for.

*Work-life balance.* One non-persister, Henry, said work-life balance was a factor in his decision to leave engineering. Henry said he wanted more time with his family and to live with them for a few years in the country his wife was raised. He left engineering to move overseas with his family and did not pursue engineering work as he did not think he would be able to find a job in that country.

*Money.* Henry was the only non-persister who said he left engineering because he felt he did not make enough money. Henry lived overseas for a few years and upon returning to the US had planned to go back to engineering but found he could earn more as a technician, which he decided to pursue instead. Henry said he had gone into engineering for the money and when he did not feel he was making enough, he made the decision to leave for something more lucrative, even though he felt working as a technician was a step back in his career.

*Too much interaction.* One non-persisting man attributed his departure from the field to his underestimation of how much engineers work with other people. While Joe said the level of interaction in engineering was not the only reason he left, he explained it was part of his decision:

I think I had a misconception as to what engineering is...and what it requires of someone as a profession. The thing is that what they teach you of engineering in school is not even the tip of the iceberg. In engineering you deal with people as much as you deal with things.... As much as a doctor needs a bedside manner an engineer needs to be able to deal with people in particular ways and it would be a great service to tell people that before they enter into the profession.

### **Identity.**

*Male persisters.* Identity was either discussed, or the participant referred to himself as an engineer, in 13 of the 14 interviews with men who have persisted in the field.

*Identify as engineers.* Twelve of the persisting men said they identify themselves as engineers. When asked to explain what makes them an engineer almost half cited their problem solving abilities. Other common responses were they liked designing and building things, understanding how things work, and improving things. Several men also felt their job, degree or technical knowledge were aspects of what made them an engineer:

I think it's kind of the combination of I have a degree in engineering and I've kind of pursued things that are typically considered [in the] engineering category. But I think it just might be maybe more the curiosity of how things work, the desire to design and build whatever. Um those are some pretty deep characteristics of what engineers do. And love to solve problems within the natural world. (Steve)

I work as an engineer... Engineers see things a little differently. Like I've already looked at all the lighting in here and seen how it's all connected. I'm real intrigued as to why they're doing what they're doing. (Andrew)

*Identity through relationships.* Eleven of the persisting men identified themselves through relationships with family and friends. For example, Max said, "I am a husband and father...provider and electrical engineer... I'm a son and a brother."

*Does not identify as an engineer.* Only one persisters, Phil, said he does not see himself as an engineer. Instead, Phil finds his identity as a husband and a father, and says that although he is currently single, in the future he wants a wife and children to be central elements in his life.

***Male non-persisters.*** Identity was discussed in nine of the 10 interviews with non-persisting men.

*Identity through relationships.* Seven of the non-persisting men identified themselves through their family relationships. For example:

I think first and foremost is as a husband and then very closely paralleled to that is a father.

(Mark)

I'm a husband now...I'm a son and I'm a brother. (Chris)

I'm a father, I have my wife and two kids so I'm a father to two kids. (James)

*Identify as engineers.* Five of the non-persisting men said they still see themselves as engineers.

Three of these individuals said they consider themselves engineers mainly because of the way they think. Bill for example said:

If I had to boil it down to one thing that would be the way that I think and the way that my mind works....I'm very logical in all of my decisions....very process-oriented in how I make all of my decisions. It's how I live my life; taking all the info, analyzing the info and then making a decision based on the info.

Mark, like Bill, also continues to identify as an engineer even though he is now in a management position. He feels he still uses engineering in his job and notes that others see him as an engineer:

I think I've always relished and cherished the fact that I have an engineering background. It comes up; people characterize me as an engineer because they see that, the problem solving, the analytical perspective, what are the numbers, show me the numbers; they'll tell the story.

I think it's been engrained in my persona, that technical bent. (Mark)

Being an engineer is a strong part of Henry's identity and a piece of himself he speaks about with pride:

I always consider myself an engineer.... it's just part of that pride that I have. If I just went to community college for two years and became an engineer, I don't think I would have that identity. But I had to work incredibly hard....And the things I had to go through to get that and knowing I had wanted to do that for so many years, and being able to do it you gain such a sense of satisfaction it just becomes part of you. So I could never not be an engineer.



When people ask me what I do, I always tell them I'm an engineer but I work as a technician. So I'm always going to be an engineer.

*Identity through jobs.* Three of the non-persisting men identified themselves through their work roles outside of engineering. For example:

I am a project sales manager for a company in the town that I live in. (James)

I'm an officer so some kind of leader in the Air Force. (Chris)

### **Female Persisters.**

*Reasons to stay.* Twenty-one of the 24 female persisters discussed the reasons they have stayed in the field of engineering.

*Enjoyment of engineering work.* Twelve of the persisting women said they stay in engineering because they like the kind of work they do, and enjoy the challenge and variety they encounter in their jobs. Several women talked about their plans to remain in engineering their entire career citing the interesting projects they have had the opportunity to work on as a significant factor in their intentions to persist. Stacy is one who loves the variety in her job:

Kind of the day to day changing aspect of the work. It's not the same thing every day. You know, you get calls- 'oh no there's like this green slime on the part, where did it come from?' You know, 'what is it, where did it come from, how do we get rid of it, what do I do?'... so it doesn't end up being the same old, same old, you know, day to day grind. So I think I find that very entertaining and challenging and so that makes me want to keep going.

Another woman, Rachel, finds the changing nature of the field itself engaging, saying what motivates her to persist is, "the challenging aspect of engineering and the fact that it's always changing.... There's always new technology and new things to learn. I think that that continues to make me interested and it doesn't get boring that's for sure." Several of these women said they could not see themselves doing anything but engineering and were satisfied with their career choice.

For Stacy, being away from her job for a few months after her son was born highlighted to her just how much she liked what she did and that she missed it:

I would talk my husband's ear off when he got home because he's also an engineer. And I was like, 'well what did you do today, well what did you work on?'... It made me realize how much I missed the engineering again and the day to day excitement of what was going on at work.

For women like these, their love of engineering and the challenges of the work motivate them to persist in the field.

*Money.* For six of the persisting women, their income was a motivator to stay in engineering. For some, simply feeling they were paid well was enough to encourage them to persist. Others however, had families who relied on their earnings. Jill for example said:

The income piece that I contribute is significant. And, we've tried to be reasonably frugal in how we live, but it would be a real struggle for us to manage without my income. So, from a family standpoint, we rely on that piece of what I contribute. And I think that I am happier and more balanced in my marriage knowing that I contribute some of the financial side of it too.

For Jill, income was important not only because her family needed it financially, it also made her feel more like an equal partner in her marriage. Mollie also works to help support her family because her husband is a missionary and is not paid for his work. Being the only earner in their family does not bother her as she feels, "it's kind of almost my mission work is being an engineer and that it can support our family and free us up to do mission work that my husband does."

*Work-life balance.* A factor that affected five of the women and their intentions to persist was their ability to establish work-life balance. Lynn's comment reflects a sentiment shared by many of the women, saying, "I think the biggest challenge for us women in engineering is finding a balance in

life.” Several women stated that their ability to balance work and family encourages and enables them to persist in the field. While balancing these two aspects of their lives takes work, many of the women had taken steps to enable them to engage in both. Those who were able to find work-life balance did things like find engineering jobs that would allow them to work flexible or part-time schedules and shared parenting duties with their spouse. Tina, for example, uses the flexible schedules her company offers its employees and works four 10-hour days each week. She said because she is able to work this modified schedule, “I’ve felt that I can continue working full time, be a good engineer and be a good mom and I’ve never felt like the two competed or that I’ve had to let one suffer in order to do the other.” She also credits her husband’s support in helping her create balance and persist in the field saying:

If I have to work overtime for any reason, I’ve got a deadline you know or whatever, he’s of course there to pick up the kids from school, feed them dinner, put them to bed all without me. He’s always been a hands on dad, he’s always been capable of doing it all with or without me there. He can totally fill in and fill both mom and dad if necessary.

Colleen’s husband’s startup business was struggling, causing them to rely on her for income. When she went back to work, her husband, who worked from home, took on a greater proportion of the family responsibilities. She feels her husband taking on these responsibilities is the reason she was able to work, saying:

I couldn’t have done it otherwise. He would drop [the kids] off or pick them up from daycare a lot of the time, or one of us would and the other would pick them up. He does all the cooking so that helps a lot too. So I go home and dinner is on the table.

Others coordinated with their spouse to decide whose job would be consistent and who could have more flexibility. Tina, for example, said she could not work in the construction division of her company because:

You have to be there when the contractor starts working. You have to. If something breaks in the middle of the night, you get the call and you have to go out there. I can't do that. My husband's job, his schedule is crazy. Mine has to be the consistent one. I have to have consistent working hours. I can't be asked to stay and work overtime at a moment's notice.

In situations like this, the women typically had engaged in conversations with their bosses to establish boundaries and create a plan that worked for them and their family.

***Reasons for leaving.*** When asked if they have considered leaving engineering, over one-third of the persisting women said they did not want or intend to leave the field. Four women were not asked the question.

***Work-life balance.*** The most frequently cited factor that makes persisting women consider leaving engineering was work-life balance, which was discussed by five. Many of the women discussed how difficult it can be to have a life or family outside of work with the long hours common in engineering. For many of these individuals, work was often stressful and demanded a lot from them. According to Angela, who typically worked 60-70 hour weeks, "An engineer is a very exhausting job, I think a lot of energy is expended mentally and I think that coming home and expending more energy is hard." Similarly, Rachel said:

There's long hours, a lot of hours, there are definitely times when I'm working a lot and I'm tired. And it's you know, I've thought, it would be so nice to only work forty hours....maybe it would be nicer if I didn't have to think so hard all the time and had it a little easier sometimes....It's a pretty stressful job so when it's high stress, lots of hours, it can be tiring, but I think ultimately, even when I'm past that crazy time, I can think...know that I still like it.

For many of the persisters, like Rachel, who was able to keep sight of the fact that she likes what she does in the midst of stressful times, the long hours were not an influence to leave engineering but to

find a new job or shape their current job to meet their needs. Lynn, who liked her job and the company, came to a point where she had to think about her future and how her career played into that. According to Lynn, “That’s one of the things that a woman faces in engineering is what do you want to do for the rest of your life and how do you want to balance that with having a family.”

Lynn said her company was grooming her for advancement:

But I had to balance that with what I wanted to be from a family point of view. A couple things were going to hold me back from dedicating my life to [company]. One is I could see that I was going to have to move, and we were pretty grounded where we lived.... I also looked at other women who were juggling babies and children and management, and [company] demanded a lot of time if you wanted to advance... You didn’t have any time to spend with your child, you know they had nannies or they had someone to do substantial child care because they were gone so much. So I wasn’t sure if that was what I wanted to do for the rest of my life.

In order to allow more time with her family, Lynn made the decision to leave her company to look for an engineering job that was not as demanding. Claire also wanted to move into a management position within her company and sat down with her managers and said, “Hey, for me, children are in the future, you know, a year, year and a half out.” She went on to say:

In most companies, I don't think I would feel the need to do that.... [but] we're a fairly small company and they've never had a woman in a management position there.... And, I wanted to sit down with them to make sure that working part time for a few years wouldn't side track my career.

Claire said that had her company been opposed to her working part-time she would have left to work for an organization that supported her in this decision. The work-life balance issue Stacy faced was too much travel which she felt made her miss out on too much time with her children. After

leaving the company she was travelling frequently for and finding a new job, she realized that travel is not always as extensive as it was in her job, and said, “it turns out it was more of a company rather than an engineering [thing].” Many of the women who had considered leaving their jobs or engineering because of work-life balance issues, made modifications to their job or looked for a new role within the field that allowed them to stay in engineering and still have the life they wanted outside of work.

*Discrimination/poor treatment based on gender.* One theme that was common throughout the women’s interviews was the issue of gender. While half of the women talked about the gender disparity in engineering and the problems it has caused for them, only four said they have considered leaving the field as a result. These women were bothered by “girly posters” in the office, the presence of “good ol’ boy clubs,” and working with people who did not respect women. For example, Janet said:

And it still is very much a man's world in that there tend to be, at least clusters of the older guys that are the “good ol’ boys club” mentality that think that you're not competent because you're a woman and it feels like you have to fight a lot harder to prove that you know what you're talking about or prove that you're competent.

Those who experienced these types of environments and mistreatment based on their gender, at times, felt it hard to continue in the field as a result of the way they were treated.

*Mismatch in values.* For two of the women, a mismatch between their personal values and the values or culture of their company encouraged them to leave their jobs. Pam left her job with a defense contractor after taking a trip to Africa during a time when she was “working on programs where the government is spending a million dollars a day on an army program and that’s like a drop in the bucket.” Frustrated by how much money the US puts toward defense and the good that money could do for people in need, she decided to leave her job for one that did not contradict her

beliefs. Unfortunately, over time she also found a mismatch in values at the company she moved to as well:

My frustration lies with companies that green wash or don't sell themselves- they sell themselves as a company that's either renewable or sustainable or green but in reality they're not. And in my opinion, [my company] is a green washing company, and so in the last year or two I've just decided that it's- I don't want to be a part of it. So I'd rather- I'm not close-minded towards working with another company that is doing engineering...but I think the intentions of the company need to be right.

Pam's love of the environment made it challenging for her to work for a company that falsely said they were green to win contracts. This type of dishonesty about their practices was something she did not want to be part of and encouraged her to consider leaving the company. Danielle's story is similar in that she made the decision to leave because she saw something in the company's culture that was not in line with her values. Danielle was sent to another country to fix an issue on a boat that was at sea. She described the interaction between the engineers in the country she was working, the sailors of the boat, who were from a different country than the engineers, and herself, as a "major cultural quandary." She said the:

Engineers weren't use to working with women. The sailors were, well, they were sailors, and so their etiquette was lacking.... I was having trouble with all sorts of things. Harassment or bribery, or whatever, but when I came back home the company said, 'well our solution is we would never send a woman out on a job like that ever again it's just too much trouble.'

Which I thought really was the wrong answer, so like I said, eventually I wound up leaving that job because the culture of that company wasn't what I was looking for and I didn't see a way of changing it to be something that I would want to work in.

For Danielle, the way her company handled the situation highlighted a mismatch between her values and the culture or values of the organization. She tried to think about changes she could make to improve the culture and make it a place she wanted to work but did not feel she could do so which resulted in her departure from the company.

*Challenges with coworkers.* For two of the women, challenges with coworkers made them consider leaving the field or their job. Danielle, whose story was told above about working on the boat, said the situation strained her relationships with engineers she worked with to the point she left the job because she wanted to get away from the people. Stacy also gave an example of a situation she had faced earlier in her career that made her want to leave. While working on a large team charged with making a machine operate properly, she found the data she was analyzing did not make sense so she took it to the team for help:

And so I was in this meeting and I had you know, been sharing the results with the group and I said, 'here's what happened, this wasn't what we had expected and does anybody have any ideas? You know, is this real, is this not real? Is there anything going on here that I'm missing?' And so everybody is sitting there pondering while staring at the screen, and thinking about it and you know a few ideas are being thrown out and then this one guy says, 'well, if you're too stupid to figure it out then you shouldn't be in engineering.'

Stacy pointed out the man did not provide a solution to the issue with the machine and “was just being a jerk.” However, she said “sometimes you run into this [behavior] and you go, why am I doing this?” For Stacy, these types of situations made her consider leaving engineering.

*Isolation.* Two persisting women had considered leaving engineering because of how lonely and isolated they felt. In addition to being minorities because of their gender, both women commented they are much younger than the men they work with so they are also minorities because of their age. Erin commented her coworkers in previous jobs have been close to her age and that



they would “all hang out together.” In her current job though, the men all go out together but she is never invited. The other woman, Anna, has found that her male coworkers with daughters her age are better at connecting with her, but even those individuals do not include her in things like going out for lunch. Until recently, Anna was the only female in her group and said, “before [the new female engineer] got a job here, I was about ready to quit because I was very alone.”

### **Female non-persisters.**

***Reasons for leaving.*** All 13 of the non-persisting women discussed the reasons they left engineering.

*Competing interests.* Five women said they left the field because of other interests they wanted to pursue outside of engineering. For some of the women, exposure in their jobs to non-engineering projects and tasks helped them find an interest they did not know they had and encouraged them to pursue a non-engineering role. This type of exposure highlighted other interests to Madison who said, “because I was exposed to more than just engineering that exposure kind of drew me away from engineering because I liked what I was exposed to more than what I had been doing.” Similarly, after being laid off from her engineering job, Lindsay had to take a position in another field because she needed work. In the new job she discovered an interest that has prevented her from wanting to return to engineering, “because I found there was something else I loved more and that was working with customers and finding out what they needed to do and actually impacting millions of people and that was what I wanted to go do.”

Karen felt that although she liked engineering, there were other things she wanted to pursue: I just have a lot of different interests. You know, I enjoy all the logic stuff that I did in engineering, but I also have a lot of other interests in things that I'd like to do. So it was kind of, you know, okay for a time but there's a lot of other things that I'd like to pursue.

Karen, and two other women who left to pursue other interests, discovered a passion for teaching. These women liked that they were still able to use their math and science background from engineering, but apply it in a different way:

The last semester that I was [in graduate school], I TAed for freshman chemistry and I loved TAing freshman chemistry like I had never loved anything in any part of my engineering career. And I realized that people do teach, that's a field, that's another viable job, people do that... Now I'm a high school chemistry teacher, partly because teaching fits really well in a family schedule but teaching is also what I really, really love. So it's not so much a rejection of engineering, it's an evolution of realizing what I love and what I'm good at. (Monica)

Monica's comment about her departure not being a rejection of engineering is representative of all five of the women who left to explore other interests as none of them left with the purpose of getting away from engineering itself.

*Children.* Four of the non-persisting women attributed their departure from the field to having children and wanting to be home to care for them. Two women said they had planned to be stay-at-home moms and the other two had intended to continue working, but ended up leaving engineering after their children were born. Leaving the workforce after they had children was the plan for both Karen and Jen. Karen said, "I have always known that I wanted to be a stay-at-home mom... So I guess I knew from the get-go that engineering wasn't going to be a lifelong thing." Jen and her husband had also planned she would stay home with their children, yet she worked part-time until their second child was born, childcare became more challenging, and her job changed to the point she no longer found it interesting.

Carrie and Sarah, in contrast, had intended to return to engineering, but both felt a pull to stay home after their children were born. Sarah had planned to go back to work part-time, but after sitting down one day to ask herself what her priorities were, she realized:

My priorities in 20 years will be that I raise my kids [rather] than work for [company]. I wasn't going to be the innovator that was going to invent something or discover something very wonderful. I was going to be a good employee and a valuable employee but it wasn't earthshattering that I was going to leave the field.

Carrie too had planned on returning to work but changed her mind after talking to a female coworker about the decision who told her, "it's okay to change your mind." Carrie went on to say:

And I held that little baby and I went, maybe it's okay to change my mind! Maybe I don't have to do it full-time and ship my kids off. Maybe I can bend a little.... I really wanted to be the person raising my kids when they were little.

Whether or not they had planned on staying home to raise children, the women who left engineering to do so felt a pull away from work in general to be home with their families.

*Discrimination/poor treatment based on gender.* Many of the women interviewed had experienced some form of mistreatment because of their gender, but for two non-persisters, Kristen and Hannah, the situations were severe enough that it made them leave engineering entirely. In Kristen's first engineering job, she was the only female in a company of about 200 male engineers. She said her boss had pin-ups and told her that "women belonged barefoot and pregnant." Not only did her boss display this type of behavior, it also came from other leaders and coworkers as well:

It wasn't really nice to be in electrical engineering. They just treated me different than everyone else and when you know, men would be in conversations, they would look at each other but they would never look at me. I was late to a meeting and I actually had the head of a department say, 'why don't you come sit on my lap? There are no seats.'

Kristen also expressed frustration that it was harder for women to move into management roles than it was for men. According to Kristen, these types of experiences made her leave the field to get

away from the people. She said, “it was really so disappointing after going through all of those years to be treated like that. It’s just so disrespectful.”

The negative experiences Hannah encountered, on the job and in interviews, motivated her to leave engineering and discourage others, including her son who loves math and science, from entering the field. Hannah explained:

When I have an interview I sometimes have funny things come up- they’re not supposed to ask, it’s a law, but for example, ‘Do you feel comfortable working with a group of guys or technicians?’ Why are they asking that style [of] question?

Furthering her frustration, when she asked the recruiter for feedback about why she did not get a particular job, she was told the team was “not very comfortable working with girls.” Hannah explained, “Yes, some workplaces don’t feel comfortable, they prefer a guy, a member, so you can share the job, do the things, go out for lunch.”

In another job interview she was asked if she has kids, which she points out is also illegal to ask. Another experience that Hannah felt drove her away from engineering was her manager asking, “are you going to have a child, be pregnant next year because I’m going to have a big project.” For Hannah, these types of experiences, which she felt would not have occurred if she were male, made her feel “that’s enough and I think enough is enough” and chose to leave the field. Hannah does point out that incidences like these are less common today but that has not changed how she feels about engineering. She said she continues to “discourage [her son] to go to engineering- anything but engineering, because it’s a field thing currently in the engineering field.”

*Difficulty of re-entry.* The majority of non-persisting women did not leave out of dislike for the field or the type of work they were doing, and many said they had considered returning to engineering at some point. However, these women expressed concern about their ability to re-enter the field because of the rate at which technology progresses and fear their skills had become

outdated, even in a few short years. This concern about the ability to re-enter the field is something Jen considered when initially deciding whether to stay home with her children:

[I] recognized because I worked in an engineering field... if I took any significant time out of the field, I felt like I would be obsolete. So it wasn't a short term decision, like in 5 years I could go back. Unless I was willing to update my skills in some way.

Jen said she knew re-entering the field would be difficult and is not interested in going back to school to get a master's degree in engineering which she felt it would take to work in the field again. For Sarah, the decision of whether or not to return to engineering arose when her youngest child left for college. Upon reflecting on her options, Sarah felt:

The problem with engineering is when you've been out of the field for a long time, especially chemical engineering, while it's a way of thinking and...using resources and while I knew I could do that and I had the correct thinking to go back in probably some sort of engineering field, I wasn't sure I had the skills anymore. When you've been out of doing the chemistry on a day-to-day basis and because there had been such incredible changes in the things that I had worked on.

Sarah concluded that re-entering the field would be too difficult and instead chose to become a math tutor so she could still do something that involved her love of math. For many of the non-persisting women, while ideally they would like to return to engineering in the future, they believe it would be too hard to go back, and therefore decide to stay out of the field and do something other than engineering.

### **Identity.**

*Female persisters.* Identity was discussed in 20 of the 24 persisting women's interviews.

*Identify as engineers.* The majority of persisting women said they identified as engineers with 15 of 20 identifying. Even many of the women who have left more traditional engineering roles but are

still in the field continue to see themselves as engineers and discussed how they apply engineering skills and problem solving. Lynn for example said she sees:

Engineering as a general way of thinking, analytical problem solving no matter what you apply it to. And I could never see myself not doing that, so it's more of a situation where I'm always doing it but just applying it you know maybe in different ways. So I did leave classical engineering you know as in more of a focused mechanical engineering where I'm just designing—designing something mechanical.

When asked if she still thinks of herself as an engineer Lynn responded, “Oh yeah. I do think of myself as an engineer for sure.” Rachel who works in an engineering job said, “I think being an engineer is a lot of who I am sort of so I think it would be hard for me not to do engineering or a job related.” When asked what makes her an engineer Rachel responded, “it's what I do for a living. It's how I think about most things, I think it's all the things I've done to get to be an engineer. It's definitely something I identify with as being a part of me.”

*Identity through relationships.* Eight persisting women identified themselves through their family relationships. All of the women who identified this way referred to themselves as a mom, a wife, or both. For example, when asked about her roles in life, Mollie replied, “Probably the first one I think of right now is mom, being a new mom. And then a wife. Then engineer's probably up there too.”

*Hesitant to tell others they are engineers.* Five women said they were hesitant to tell people they are engineers, including four who see it as part of their identity, mainly because of the way people react. According to several of the women, when someone learns she is an engineer, they tend to say something about how smart she must be and become uncomfortable talking to her:

When people ask me what I do... I'm always a little embarrassed to say I'm an engineer 'cause people think I'm too smart to talk to them and I'm not. And so I usually say oh I work at [company]. (Anna)

This is funny but I'm not quick to say that I'm an engineer.... But in social circles, I don't know, I still feel like it's... I don't know the word for it. I don't feel like I, I don't fit people's expectation of what an engineer is.... like the immediate reaction that I get is, 'Oh wow, you must be smart.' Or you know, it just, to me that's not necessarily the reaction that I want right away. You know. I'd rather meet people and get to know them....People are quicker to be comfortable with me if they don't associate me as an engineer. (Claire)

These women talked about people changing how they talked to them or treating them differently after learning they are engineers. Leah, whose husband is also an engineer, gave an example of what it is like when they get together with their friends:

Sometimes we'll go hang out with friends and nobody even asks us, 'How's work going for you?' Some of our friends don't, we think, know what we do. And so sometimes that feels a little bad. It's like, you know nobody finds what you do interesting or nobody understands what you do or you're just being left out of all of these people who can talk to each other because people understand each other. So sometimes we feel a little left out and we'll come home and kind of vent about how we have to hear about all of their jobs but they never ask about our jobs.

Pam has had similar experiences saying when people learn she is an engineer it:

Limits the interaction between people and I've noticed that, you can be in a group of friends or at a party...and as soon as somebody says, 'oh this is [Pam], she's my friend, she's an engineer,' then... that person you're interacting with kind of changes like... 'oh you're an

engineer,' instead of just taking the relational aspect between two people without the labels, you now have changed that.

For some of the women, their hesitancy in introducing themselves as engineers stemmed from feeling like if they told others they were engineers they would be bragging in a way. This was initially true for Lynn who explained:

So for a long time I wouldn't just volunteer that I was an engineer, you know? I felt like I was bragging. Maybe that's a social hang up I had that uh you shouldn't brag about- you shouldn't go around and tell people you're smart. I'm an A student. That was like, be humble. And so going around saying I'm a mechanical engineer was like... somehow I thought that was like bragging.

Over time, Lynn realized that telling people she is an engineer is not bragging and that especially when working, or meeting with customers, it was helpful when she told them she is a mechanical engineer so they knew she had expertise in that area and could have a technical conversation with her.

*Does not identify as an engineer.* Four of the persisting women said they do not see themselves as engineers, and another said she used to identify as an engineer but no longer does so. When Judy was asked whether she sees herself as an engineer she replied:

You know I probably would have, you know, ten years ago but now I'm a manager and I use my engineering skills and my engineering mind a lot but I'm not really an engineer anymore.

Yeah, I don't really, I guess I don't identify as an engineer as much as I used to.

For Judy, whose role had changed to management and no longer involved engineering, she stopped seeing herself as an engineer but felt she still used the skills and thinking she learned in engineering.

Others who did not identify as engineers tended to prioritize other roles in their lives as demonstrated by Danielle's response:



Well, I don't necessarily see myself as an engineer. I've got a job, not a career. So I wouldn't put that one first. I'd say wife, mother, and artist honestly. And I think those are the most fulfilling things. And the engineering provides the means to do those things hopefully better than I'd be able to do if I wasn't an engineer.

*Identity conflict.* One woman seemed to struggle with her sense of identity. At the beginning of the interview Anna acknowledged that she recently started seeing herself as an engineer after doubting she truly was qualified:

I think I finally started to think of myself as an engineer when I got my professional engineer license. And then I finally thought okay there really wasn't a mistake I really did pass my classes, I really did get an EIT license and I really got my PE they couldn't have made three mistakes. I thought okay I really am smart enough to do this, I really am an engineer.

Later in the interview, Anna went on to say:

Engineers are very important. In my life it's a good challenge for me to have. Keeps me thinking and it is fun to do. I'm not sure I really identify with it. Um....Like I said I just recently starting thinking of myself as an engineer. Um, it's still hard. I don't find my identity in it, let's put it that way.

***Female non-persisters.*** Identity was discussed in 10 of the 13 non-persisting women's interviews.

*Identify as engineers.* Nine of the non-persisting women said they still identify as engineers even though they no longer work in engineering. For most of these women, engineering is part of who they are and how they see themselves. For example, Abby said, "I still- even when I was a program manager I liked to say that I am an engineer because that was just, I felt like that was really at the core of what I was." Karen said, "I am an engineer. I still consider myself an engineer even though I don't have a technically engineering job. But I still, I'm in an engineering mindset."

Comments like Karen's in which she talked about her engineering mindset were common. The fact that they problem solve and think like engineers is what made several non-persisting women feel they are still engineers. These women often said they continue to think like engineers and gave examples of how they use engineering in their lives today. For example, Monica says she applies the problem-solving skills she learned in engineering with her children when they fight:

I'll hear some big explosion downstairs and I'll come downstairs and say let's take this apart or this problem and I always hear the last thing, 'he just hit me.' 'Okay but what happened right before that? And right before that? And what happened before that?' and we end up finding that it's some- much like a global problem- it's some resource- you know, there are not enough paint brushes to go around, there are not enough Lego wheels to go around, there are not enough whatever, whatever the problem might be.... Engineering is this lovely methodical approach to problem solving that I am glad I have because it's very handy.

A few of the women commented that others also notice differences in their thinking and continue to see them as engineers even though they have left the field. Several also brought up differences they have noticed between the way they and other non-engineers think:

[Engineering] is like a way of thinking, a way of being in a way. And I know it sounds kind of weird to say that but especially when I talk to some of my girlfriends now who are- especially my girlfriends who are not engineers, some of the things I say they're like, 'it's so clear you're an engineer [Lindsay].' When I was in high school, after I had my last boyfriend I wrote down a list of all of the traits that I wanted in my next boyfriend. [My friends] were like, 'You are such an engineer. Only an engineer would do that.' (Lindsay)

I think as a woman, I've always felt that I'm different than everybody else who is not a woman engineer.... how you think of the world, how you see the world, how you problem solve, it's a lot different than women who cannot be technical and sometimes with men it's

difficult. I'm a geek, you know, even though I don't do engineering every day, my brain is still a geek. (Kristen)

Sometimes the difference in how these women thought, because of their experience in engineering, made them feel different from others but they tended to see that positively and value the fact they think like engineers.

*Identity through relationships.* Three of the non-persisting women identified themselves through their family relationships. For example, when asked about her roles in life, Karen responded by saying, "Two things for sure. I am a wife and a mother." The other women who defined themselves by their family roles also listed one or both of these roles.

*Not a real engineer.* Two of the non-persisting women talked about others, not including themselves, as "real engineers." For example, Monica said:

My husband is an engineer and my dad is an engineer and they are the kind of for real engineers; the kind of people whose minds are always, even if they are not physically taking things apart and putting them back together, they're mentally taking things apart and putting them back together and figuring out how it works and that wasn't really ever me. Like I like to solve puzzles and I like to figure stuff out but I'm not a for-real engineer the way they are.

Karen was similar to Monica in that she felt she was not as much of an engineer as her husband and said, "I don't consider myself a hard-core engineer like my husband is, I mean, ALL engineering. I mean, he loves the stuff."

*Identity nostalgia.* For some, their identity as an engineer is still part of them but a piece of themselves they miss. Lauren talked about her experience as an engineer and the feeling she gets when she visits the site of a project she worked on in the past saying, "I can still walk by and if I think about it I can still smell the ammonia from the blueprints on my hand. And that was cool. I

loved that.” While Lauren no longer refers to herself as an engineer, she says she feels like an engineer in her heart and “never wants to let that go.” Lauren went on to say:

My favorite T-shirt that I will never give up is my [college] Engineering t-shirt...There is so much joy, and just so much... and I hate to use the word pride... but the word proud does make a certain connotation of I respected myself. I liked myself. I liked what I saw in the mirror because of what it started out as; as this girl, walking in, completely doe-eyed in...Engineering 101. And I liked the way I felt. I loved the fact that I could stand up straight and tall and proud and say, ‘I can do this!’ And I miss that piece of it.

For many of the women like Lauren, being an engineer was an important part of how they viewed themselves and continues to be a central part of their identity today.

*Does not identify as an engineer.* Tawnya was the only non-persisting woman who said she does not identify as an engineer. Tawnya differed from the other non-persisting women as she was the only one who had never worked in an engineering job after earning her degree. Although she does not identify as an engineer, she commented that others still call her an engineer and see her as one.

## CHAPTER IV

### Discussion

The purpose of this investigation was to gain insight into professional identity and retention in the field of engineering in an effort to understand the factors influencing the shortage of engineers in the United States. Both men and women were included in this study to allow for a perspective of the field of engineering overall, rather than limiting knowledge of the field to the views of women. Women have been the focus of past research in this area due to the substantial gender disparity in engineering where women represent only 11.7% of the workforce (NSF, 2013). While it is important to try to improve retention in minority groups, due to the dire nature of the shortage of STEM workers in the US, it is crucial that efforts be aimed at improving retention in majority groups as well if we are going to mitigate the shortage in a timely manner.

Professional identity and factors related to retention in engineering were evaluated within each of the four participant groups (i.e., male persisters, male non-persisters, female persisters, and female non-persisters). For ease of interpretation, the discussion is structured with a section for each of the three main components that were analyzed in this investigation: (a) professional identity, (b) reasons to stay in engineering, and (c) reasons to leave engineering. Within each of these sections is an analysis of the qualitative themes identified in the interviews. For each theme, the findings from the group(s) that discussed the theme are integrated to provide insight into any group-based similarities or differences that emerged. Each of these sections also includes a summary of the findings for that topic to aid in understanding.

#### Professional Identity

The first three research questions were assessed using the quantitative professional identity survey measure. An evaluation of the first research question found that professional identity was significantly correlated with persistence in the field, with persisters scoring higher on professional

identity than non-persisters, although the relationship was fairly small. For the second research question, the gender difference between the means of professional identity for men and women was not statistically significant, indicating men and women reported fairly equal levels of engineering identity.

Persisters and non-persisters were compared within each gender to evaluate the third research question. Statistically significant differences were found between the means of professional identity for persisters and non-persisters for both genders. This indicates there is a significant difference between the identity scores of male persisters and male non-persisters, as well as between female persisters and female non-persisters. Persisters of both genders scored higher on professional identity than non-persisters. While these results are quantitative, and no other quantitative studies could be found on professional identity in practicing engineers, these findings reflect trends found in qualitative work on this topic.

Past qualitative research on women in engineering (Buse, 2009; Buse et al., 2013) found female persisters were more likely to describe themselves as engineers than non-persisters. While these studies did not include a quantitative measure of identity, they found persisters showed stronger identification with engineering than non-persisters. The finding that stronger identity was reported by those persisting in the field is consistent with identity research which has found identification with a group facilitates commitment and decreases intentions to leave the group (Ellemers et al., 1997; Stets & Burke, 2000). The results of the qualitative portion of this investigation indicate, however, that the relationship between professional identity and retention in engineering is not this simple, as there were many non-persisters with the maximum professional identity scores possible on the survey, as well as persisters with remarkably low scores. One reason for the complexity found in this study was that many participants did not fall into the distinct categories of either identifying or not identifying as an engineer. A social identity approach appears

to offer a valuable framework which organizes and explains many of the findings related to identity discovered in the interviews. An overview of this approach will be presented to provide background on the theory prior to a discussion of the identity themes discovered.

**Social identity approach.** The social identity approach is comprised of two overlapping but distinct theories: social identity theory (SIT) and self-categorization theory (SCT), both of which are concerned with the way individuals define themselves as group members (Hogg, 2001; Reicher et al., 2010; Spears, 2011). Rather than assuming psychological processes account for all human behavior, this approach seeks to account for and understand the role of the social context in determining behavior (Hogg, 2001; Hogg, 2006; Reicher et al., 2010). According to the social identity approach, individuals possess multiple personal and social identities which shape their self-concept and perception of themselves (Hogg & Terry, 2001; Spears, 2011). Only one identity is salient at a time and will change depending on the social context. Personal identities pertain to individual characteristics and attributes that are unique to an individual, or involve dyad relationships with a specific individual (i.e., identities in a one-on-one relationship or interaction with a specific person) (Hogg, 2006). In contrast, a social identity is defined by Tajfel (1972) as “the individual’s knowledge of the he belongs to certain social groups together with some emotional and value significance to him of this group membership” (p. 292). Central to this theory is the idea that groups are defined cognitively as people categorize themselves and others based on perceived similarities with group members (Turner, 1982; Turner, Hogg, Oakes, Reicher, & Wetherell, 1987). In evaluating whether one is a member of a group, people compare themselves and others to prototypes, which are cognitive representations of a social category or group (Hogg, 2006; Reicher et al., 2010; Turner et al., 1987). A prototype defines a group’s attributes, behavior, and norms, and maximizes within-group similarities and between-group differences (Hogg, 2001; Hogg, 2006; Turner et al., 1987).

Social comparisons, in which people compare themselves to groups and various prototypes, are crucial to this theory as it is through these cognitive evaluations that people categorize themselves and others into social groups. If an individual feels they share a high degree of similarity with a group and categorizes him or herself as a member of the group, that social identity becomes part of his or her self-concept (Hogg, 2001; Reicher et al., 2010; Turner et al., 1987). Identification with a group provides information on who one is and who one is not, based on that social identity, as well as self-esteem when favorable social comparisons are made about the group (Hogg, 2003; Spear, 2011). Thus, there is meaning and value to be gained through identification with social groups (Tajfel, 1972; Spears, 2011). As a result of identification, an individual will conform to the group's prototypical behavioral norms (Hogg, 2001; Hogg, 2006) and form commitment to the group (Ellemers et al., 1997).

The act of categorizing a person changes how they are seen such that they will no longer be viewed as an idiosyncratic individual, but as someone with the prototypical attributes of the group (Hogg, 2001; Hogg, 2006; Turner et al., 1987). This change in perception is referred to as depersonalization in the social identity approach and occurs both when an individual self-categorizes with a group, as well as when an individual categorizes someone else as a member of a particular group (Hogg, 2006). As a result of depersonalization, more commonly known as stereotyping (Hogg, 2006), people are seen based on their group memberships and assumed to be similar to group members (i.e., in-group), and different from those outside the group (i.e., out-group) (Hogg & Terry, 2001; Reicher et al., 2010). Reicher et al. (2010) note that at extremes, this results in people being seen as interchangeable within their social category due to the homogeneity assumed among group members. Stereotypes in the social identity approach are believed to have a valuable cognitive function that helps people organize their knowledge of groups and understand the social world (Reicher et al., 2010; Spears, 2011).



In the case of engineering, if an individual engages in social comparisons and determines they are highly similar to the engineer prototype and sees this identity as one that distinguishes them from others, they are likely to self-categorize as an engineer. As a result, they will identify as an engineer, feel committed to this group, and modify their behavior to better match group norms. Conversely, if someone categorizes an individual as an engineer they would view the person as someone who has the attributes of the engineer prototype, rather than seeing them as a unique individual.

### Identity Themes

Seven themes related to identity were found in the interviews in the present investigation.

Table 4 presents rankings of the frequency each identity theme was cited within the four participant groups.

Table 4

*Rankings of the Frequency Identity Themes were cited by Participant Group*

Persisters		Non-Persisters	
Men	Women	Men	Women
<b>1. Identify as an engineer</b>	<b>1. Identify as an engineer</b>	<b>1. Identity through relationships</b>	<b>1. Identify as an engineer</b>
<b>2. Identity through relationships</b>	<b>2. Identity through relationships</b>	<b>2. Identify as an engineer</b>	<b>2. Identity through relationships</b>
<b>3. Does not identify</b>	3. Hesitant to identify	3. Identity through jobs	3. Not a “real” engineer
	<b>4. Does not identify</b>		4a. Identity nostalgia
	5. Identity conflict		<b>4b. Does not identify</b>

*Note.* Numbers followed by a letter indicate a tie in frequency. Themes in bold were found in both men and women.

**Identify as engineers.** During the interviews, participants in all four groups (i.e., male persisters, male non-persisters, female persisters, and female non-persisters) identified themselves as

engineers. This was the most common response across all groups with the exception of male non-persisters. Only half the male non-persisters reported identifying as an engineer, representing a much lower proportion than any of the other groups. Male and female persisters were more likely to call themselves engineers than non-persisters, but many non-persisters did see engineering as a core aspect of their identity. Those who identified as engineers tended to discuss similarities they have with other engineers, and some pointed to these shared factors as aspects that distinguish them from non-engineers. The tendency to classify people into social groups and focus on factors that distinguish one's group from outside groups is consistent with the social identity approach. One of the main tenets of this theory is that people engage in cognitive activities to classify themselves and others into social groups (Ashford & Mael, 1989; Reicher et al., 2010). People categorize themselves as a member of a group if they believe they are highly similar to the members of a group (Hogg, 2001; 2006), as seen in the individuals in this study who consider themselves engineers. Those who identify as engineers are embracing their professional identity (Goffman, 1959) as was also seen in many of the engineers in Hatmaker (2012) who saw engineering as an aspect of their identity.

Being an engineer was important to the identity of many of the participants and a core aspect of their self-concept, which many described as "a part" of them. The value and emotional significance of identification in the social identity approach was noticeable with individuals who identified with engineering. For many of these individuals, there was personal value and a sense of attachment and pride related to this identity. Several persisting females said they continue to think of themselves as engineers even though they no longer work in what they considered a traditional engineering role. These women felt being an engineer was core to who they were and felt they brought an engineering mindset to their jobs. Similarly, both groups of non-persisters stated they continue to think like engineers in their current jobs or their lives outside of work. Male non-persisters tended to talk about the way they make decisions using logic and numbers because of their

engineering mindset, while female non-persisters often gave examples of how they apply the problem solving learned in engineering to their jobs or personal lives.

Individuals in all four groups expressed a love of problem solving and said they think like engineers or have an engineering mindset, however, this was most commonly stated by both groups of non-persisters, followed by female persisters. In contrast to Chachra et al. (2008) who questioned whether men and women have different perceptions of engineering, and thus identify with a qualitatively different engineering, in the current investigation, few gender differences were found in participant's definitions or perceptions of engineering. Men and women in this study seemed to be identifying with essentially the same prototype of engineering and thus were identifying with the same aspects of the profession. Male persisters were only slightly more likely than the other three groups to attribute their sense of engineering identity to their enjoyment of designing, building, understanding, and improving how things work. More common than identifying with a set of activities, such as building or designing, the individuals in this study seemed to be identifying with a way of thinking and problem solving they saw as unique to engineers. Many participants talked about engineering school teaching students how to think and solve problems, with many saying this aligned well with the way their minds naturally worked. Both those who continued in the field and those who left seemed to value this skillset and see the way their minds work as different from those who did not go through the type of training received in engineering school. Many participants expressed pride for having earned an engineering degree and for the background and skillset they gained from the experience.

Considering that thinking like an engineer was expressed by participants in all groups as a key aspect in the identity or prototype of an engineer, applying a social identity approach, it makes sense that many would point to this as a factor differentiating them from non-engineers. When individuals make social comparisons, they are motivated to see similarity with group members

because it validates their identity and membership in the group (Hogg, 2006). Conversely, comparisons with out-groups are focused on establishing and accentuating the in-group's distinctiveness from other groups (Hogg, 2006) on dimensions that are important or salient to the group (Spear, 2011). According to Spear (2011), groups are motivated to distinguish themselves from others as distinctiveness provides a meaningful identity to the group and helps individuals understand who they are. Those in the present investigation who talked about the way engineers think and cited this as a key aspect of what separates them from others were demonstrating this principle. These individuals saw their way of thinking as a factor that distinguished them from out-group members, who in this case were non-engineers, and found pride and meaning in this aspect of their identity.

Groups tend to see out-group members as homogenous (Lalonde & Gardner, 1989), and for those in the present study, non-engineers were seen as non-technical thinkers who did not think like engineers. This principle was also seen in reverse, with participants giving examples of non-engineers perceiving homogeneity in engineers, such as the non-persisters who said others still call them engineers because of the way they think. This finding aligns well with the premise of the social identity approach that one's membership in a group influences how others know and identify them (Hogg, 2003). For those who have left engineering but still have a tendency to think like engineers, the fact they display attributes common to members of this group and match a highly distinctive aspect of the prototype, may encourage others to continue associating them with engineering. Others continuing to identify a non-persister as an engineer after they have left the field may maintain the non-persister's sense of engineering identity, especially if engineering was an important part of their identity prior to leaving.

**Identity through relationships.** Across all four groups, participants identified themselves by their relationships with others. This was the most common identity theme for male non-

persisters and the second most common for the other three groups. For most groups, these identities were based on their family relationships, although a few male persisters also referred to themselves as a friend. Participants in all four groups tended to identify with particular roles, such as a husband or wife, and many identified themselves as a parent. These types of roles are seen as personal identities in the social identity approach, of which an individual can possess many, as these identities will differ by context (Spears, 2011). According to Spears (2011), other conceptualizations of identity beyond personal and social identities, such as Brewer and Gardner's (1996) relational self, are unnecessary as in SCT, "self-definition is always relational and comparative, be this (inter)group or (inter)personal" (p. 208).

Relationship roles appeared to be important to many of the participants and a fundamental element of themselves. Surprisingly, relationship identities were much more commonly cited by men than women. In both groups of men, only two participants in each did not list a relationship identity. Interestingly, for women, persisters were more likely to discuss relationship identities than non-persisters. Considering the common explanation in the literature that women leave for family-related reasons (Hewlett et al., 2008), one might expect non-persisting women to have the greatest proportion of family identities, yet in this study, this group was by far the lowest in relationship identities. These findings on the prevalence of men identifying as spouses and fathers versus women identifying as wives and mothers, may provide evidence that men in this field do not necessarily see themselves as the macho male engineers who cannot relate to family issues like the literature portrays. Whether or not these men assist with family duties and responsibilities cannot be determined by this investigation, but it does show that men are highly aware of these roles and see them as a salient component of their identity.

**Does not identify as an engineer.** A few participants in each group except for male non-persisters said they did not identify as engineers. When asked if they see themselves as engineers,

only a small number of participants verbally denied the identity, with most instead listing other identities through which they defined themselves. Denial of an engineering identity was most common in female persisters, where four said they did not see engineering as part of their identity. Each of these women cited a different reason for not identifying; one saw engineering as a job rather than a career, another does not like labels, one was experiencing an identity conflict, and the other no longer identifies to the extent she used to since she now works as a manager. The only non-persisting woman who said she did not identify had also chosen to not seek engineering employment after earning her degree. Despite her not identifying with engineering herself, she noted that others call her an engineer and see her as one because of the way she thinks. This tendency for others to see an individual as an engineer because of their thinking was found in other participants in this study as well, and highlights the role of prototypes in shaping knowledge or perceptions of social groups.

None of the non-persisting men denied identifying with engineering but instead listed relationship identities or other aspects of themselves they see as more central to their identity. A few participants in this group named their job titles, but most commonly, they listed roles related to their relationships or social identities such as father, husband, and friend. Only one male persister said he did not identify as an engineer, and like the male non-persisters, said he finds his identity in being a husband and father. Interestingly, in contrast to findings by Hatmaker (2012), no one in this study denied an engineering identity because they did not want to be associated with the stereotype of an engineer or the field, nor did they try to distance themselves from any of these aspects. Rather, these participants appeared to be prioritizing other roles in their lives over engineering, or focusing on aspects they saw as consistent with their self-perception.

In terms of a social identity approach, the social comparisons engaged in by the individuals who did not identify as engineers did not seem to highlight enough similarity with the engineering

prototype to encourage identification. As a result, these individuals did not identify as an engineer and instead adopted other salient identities that provide them identity and meaning.

**Hesitant to tell others they are engineers.** Persisting women were the only group where participants said they were hesitant to tell others they are engineers. This sentiment was expressed by several persisting women, all but one of whom does see engineering as part of her identity. Those who expressed this hesitancy tended to do so because of the reactions they receive, as people typically comment on how smart they must be, which made them feel uncomfortable. Similarly, Gill, Mills, Franzway, and Sharp (2008) note that people say “Oh you must be very clever!” to Australian women engineers, but not men, when they hear what they do (p. 223). Although the women in Gill et al. (2008) did not appreciate this response, it did not appear to reduce the likelihood they would share this information with others, like it did in this study. These types of reactions to women indicate that when others learn they are engineers, it triggers cognitions about the prototype of an engineer. The fact women reported others commonly say something about how smart they must be suggests intelligence is seen as a distinctive factor in the engineering prototype, not just for engineers as seen above, but also for out-group members.

None of the women talked about how they responded to others’ comments about how smart they must be. However, if they were to downplay their intelligence to make it easier for others to relate to them, over time they may come to believe they truly are not all that smart. In a field like engineering where competence and thinking like an engineer appears to be a crucial aspect of the professional identity (Hewlett et al., 2008; McIlwee & Robinson, 1992), this belief could be particularly damaging.

One persisting woman worried if she volunteered that she was an engineer, others would think she was bragging about her intelligence. Eventually she realized that within the context of work, sharing this with clients and people she worked with was important because they did not

automatically see her as an engineer because of her gender. During conversations she could tell the other person was wondering who she was and what her credentials were, and found that when she stated she was a mechanical engineer, it allowed them to have a more technical conversation than when she did not make this clear. Girls tend to be taught from a young age not to stand out or brag; that being humble is a valued trait in a woman (Heppner & Fu, 2011; Moore, 2006). Men, on the other hand, are socialized to champion themselves and their accomplishments (Heppner & Fu, 2011), an aspect of the engineering culture that has been widely noted (McIlwee & Robinson, 1992; Hewlett et al., 2008). Thus, in a culture where members boast about their accomplishments and intelligence, those who are uncomfortable with doing so may be at a disadvantage as their successes and contributions go unnoticed.

Another factor that made women hesitant to tell others they are engineers was that people treated them differently and had a hard time talking to them after learning this. Overall, the women in this category seemed to be tired of being treated differently because of their profession. For women in this field, who are typically minorities at work and seen as different, it is likely that outside of work they desire just to be seen as “normal.” This feeling of hesitancy in telling others they are engineers did not appear to reduce the sense of engineering identity these women possessed; it was more of a way to project an image they were comfortable with to those outside of work. People engage in impression management strategies to portray an image of themselves to others they are comfortable with or to present an image congruent with their self-perception (Goffman, 1959). It may be that professional identity as an engineer is a core aspect of identity for these women, but one they like to have in the background when outside of work, encouraging them to engage in impression management to present an image other than that of an engineer.

A related explanation for this finding is that these women may be experiencing conflict between their identity at work and their identity outside of work. According to the social identity



approach, people possess multiple identities, which change depending on the context or situation (Hogg, 2001; 2006; Tajfel, 2010). In the case of this study, it appears that even if a woman's identity as an engineer is not the salient one she holds outside of work, others seem to have a hard time seeing her as anyone other than an engineer. The difficulty these women experienced in social settings and the responses they received suggest the prototype of an engineer is strong in the minds of others, and significantly influences perceptions. It may be that some identities, like an engineering identity, are overpowering or more resistant to change between contexts than others, preventing people from modifying their views of an individual regardless of the setting or the various identities the person holds. As a result of people not looking beyond women's identity as engineers, women in engineering may be motivated to hide this identity when outside of work as a means of getting past this barrier to build relationships. This seemed to be the case for a couple of women in this investigation who said they often do not tell someone they are engineers until they have known the person for several years. This may be a strategy these women have adopted as a means of ensuring people get to know them and their identities beyond engineering, prior to sharing their professional identity.

The only other study found where women displayed a degree of discomfort with identifying as engineers was Hatmaker (2012). A few women in Hatmaker's (2012) study distanced themselves from aspects of the engineering stereotype they felt were incongruent with their identity, such as engineers being asocial, yet they did not portray a sense of hesitancy in identifying themselves as engineers. A potential reason this behavior may have arisen in the persisting women in the present investigation, but not other identity studies in engineering, is the way the question was phrased during the interviews. To assess identity, participants were first asked what they saw as their roles in life, to which many asked for clarification. The interviewers often responded by asking how they introduce themselves and gave examples of roles such as student, researcher, or daughter. This

explanation may have induced thoughts about how one describes themselves to others and the image they like to communicate in a social setting. This potentially could have encouraged participants to share feelings of hesitancy which may not have arisen had the exchange not progressed in this manner. Regardless, it highlights the idea that people may face context-dependent identity challenges if there is tension between the image they are trying to portray in a particular situation and other aspects of their identity they feel are being imposed on them. It may be that those who are comfortable with their engineering identity, both within and outside of work, have better identity alignment, which facilitates their persistence in the field. Future research should examine this idea and assess whether alignment in identity between different contexts in one's life relates to persistence in engineering.

**Not a real engineer.** Two non-persisting women said they considered themselves engineers, but during the interview, they contrasted themselves from men they felt were “real” engineers. For both women, the differences they perceived between themselves and prototypical engineers prevented them from seeing themselves as full group members. Consequently, they did not strongly embrace engineering as a group identity. Their identities as engineers did seem to have personal meaning and value, however, as they did consider themselves engineers, just not “real” ones. One of the two women is an engineering professor, and expressed part of the reason she is not a real engineer is because she works in academia rather than industry. Interestingly, this woman also reported herself as a non-persister on the survey despite working as an engineering professor. Distinctions such as these are consistent with past research (Faulkner, 2007; McIlwee & Robinson, 1992) which has found that within the field, there is a common perception that only technical work constitutes real engineering. It is likely these beliefs were learned through the culture of engineering and the prototype of who engineers are and what they do.

This theme underlines the need to diversify the definition of an engineer to accurately reflect the range of roles and the heterogeneity that exists in engineering. Expanding this definition to include the broad range of roles and skills used in this field will likely help a greater number of people feel part of the profession, instead of making all those who do not engage in the hands-on technical work feel they are not real engineers. This need to redefine engineering and broaden the definition of what engineers do will be discussed further in the overall future research section.

**Identity conflict.** One persisting woman appeared to be struggling with her sense of engineering identity at the time of the interview, initially saying she sees herself as an engineer and later saying she does not see engineering as part of her identity. It appears that the main reason for her identity conflict is a lack of confidence, which prevented her from seeing herself as an engineer until shortly before the interview was conducted. When asked if she thinks of herself as an engineer, she explained she only recently began to after receiving her Professional Engineer (PE) license. Prior to this time, she thought she may be working as an engineer only because of a series of mistakes. Upon earning her PE license, she finally believed she was smart enough to be an engineer and began to see herself as one. Towards the end of the interview, however, she goes on to say she does not find her identity in engineering, explaining that she only recently began to think of herself as an engineer. Since accepting herself as an engineer was new for this woman, after struggling for years with the idea she was unqualified, it may be that her identity as an engineer had not yet solidified at the time of the interview. Her lack of self-confidence with regards to engineering seems to be deep-rooted and will likely take time for her to overcome before she can truly see herself as an engineer. A lack of confidence was discussed in several of the persisting women's interviews, but only seemed to hinder identification for this one individual.

This woman's struggle with her engineering identity appears to be the result of the imposter phenomenon in which individuals fail to internalize success, and therefore attribute their attainments

to luck or effort (Clance & Imes, 1978). Despite contradictory evidence which should provide ample evidence to the individual of their abilities, they continue to believe they are not intelligent and experience anxiety, worrying they will be exposed as a fraud or imposter (Clance & Imes, 1978; Sakulku & Alexander, 2011). Similarly, the woman described above believed earning her degree and EIT license had been mistakes rather than attributing these successes to her intelligence or abilities. The fact she had begun to see herself as an engineer after earning her PE license indicates she may finally be internalizing her success. Over time, this may curtail her feelings about being a fraud, enable her to accept that she truly is qualified, and identify as an engineer.

**Identity nostalgia.** For a couple of the non-persisting women, their identity as an engineer is a part of themselves they miss. Women who talked about missing this part of them spoke wistfully about their experience in engineering and the pride they felt for their past work accomplishments. One woman expressed admiration and respect for the person she was as an engineer and misses that part of herself. While she no longer calls herself an engineer, she said she still feels engineering is a part of her and a part she does not want to let go. Some of the non-persisting women who talked about missing their engineering identity pointed to the number of years they spent studying engineering and working in the field, noting this comprised a significant portion of their lives. Although these women missed their identity as an engineer, none expressed any intention to return to the field. Many of these women nevertheless talked about ways they apply engineering to their current jobs or the value they see in the training and skillset they received from engineering.

No other studies found on identity in women engineers have reported that participants missed their engineering identity after leaving the field. It is intuitive however, that someone would have these types of feelings after leaving something they had dedicated years to and been interested in. Thus, it is somewhat surprising this has not been found in other studies and that male non-

persisters did not express feeling any sense of longing for the person they were when they worked in engineering. This may suggest non-persisting men do not feel a loss of identity like some of the non-persisting women did after exiting the field. This may be the result of engineering being gender consistent for men, facilitating their ability to continue to identify as engineers after leaving.

**Summary of identity findings.** The facet of identity of particular interest in this investigation was professional identity as an engineer, which was assessed both quantitatively and qualitatively. Participants differed in the level of professional identity reported and the way they thought about their various identities, however, a great deal of similarity was found between men and women. No gender difference in professional identity was found on the survey meaning that men and women reported fairly similar levels of identification with engineering. Within each gender there was a difference in the scores of persisters compared to non-persisters, with both male and female persisters scoring higher on professional identity than non-persisters.

Seven identity themes were found in this sample suggesting engineering identity is more complex than whether or not an individual identifies as an engineer. Identity appeared to be more slightly more straightforward in men than women as the only identity themes that arose in the men's interviews were identification, non-identification, and identity through relationships and jobs. The majority of women fell into these same three groups, although four additional themes were found in women, who appeared to experience greater diversity and conflict in their engineering identities than men. A social identity approach (Turner, 1982) was applied to the identity themes in this investigation, which appeared to offer a valuable framework and explanation for many of the interviews findings. Consistent with a social identity approach, there were aspects discussed by both persisters and non-persisters that appeared to be deeply rooted components of an engineering identity or prototype.

The men and women who identified as engineers often described engineering as a part of them and talked about how engineering fits with the way their minds worked. There was a significant emphasis on the way engineers think, with both persisters and non-persisters explaining those outside of engineering do not think technically or problem solve like they do. These distinctions between engineers and non-engineers demonstrated the presence of in-group/out-group thinking as participants tended to consider out-group members to be non-technical thinkers. It was interesting to find the emphasis on thinking like engineers, and comparisons to the way non-engineers think, were more common in non-persisters than persisters. This may indicate non-persisters, who feel engineering is part of their identity, maintain their engineering identity after leaving by focusing on their similarities with engineers or communicating what still makes them part of this group. By emphasizing the fact they think like engineers, an aspect of the engineering prototype that appears to be paramount to this identity and a highly distinctive aspect of this group, non-persisters may be able to preserve their engineering identity. Being employed in the field likely makes it easier for a person to be identified by others as an engineer than someone who has ended their membership by leaving. Thus, by focusing on their similarities with the engineering prototype, non-persisters may convince themselves and others they still belong to this group.

Identification with engineering may be limited in individuals who do not match the engineering prototype as was demonstrated by several men and women in this investigation. Several women persisters pointed out they identify as engineers even though they do not work in traditional engineering jobs, and two non-persisters who perform work related to engineering, felt they were not “real” engineers. Although their identity as an engineer seemed important to these women, it appeared to be one they held somewhat privately due to the differences between themselves and the engineering prototype. This type of uncertainty in identification was also seen in several men and women who were considering moving to, or who held, management roles. There seemed to be an

identity conflict faced by several participants related to whether or not managers were engineers. As a result, some of these individuals did not consider themselves engineers because they held management roles. Examples such as these highlight the problems associated with the narrow prototype of engineering. The current prototype contains distinction about what constitutes engineering work and excludes a large number of people who work in this field from feeling they are full group members. This poses a threat to professional identity, as those who deviate from this narrow view may feel they do not belong, and consequently are at an increased risk of leaving.

It was clear in the interviews that most participants had multiple personal and social identities, as seen in the social identity approach. Most participants listed a variety of roles they held both within and outside of work that comprised their identity. Within each of the four groups, participants commonly explained their identity in terms of personal identities based on relationships with others. Personal identities such as mother, father, or spouse, were often cited in addition to an engineering identity, but some only seemed to find their identity in these relationships.

Although discussed by both men and women, identities based on relationships were most frequently found in males where family roles seemed to be especially central to their identities. Surprisingly, few women talked about their personal identities or being a mom, although many were parents. The idea in the social identity approach that despite individuals possessing multiple identities, only one is salient at a time and depends on the context (Hogg, 2006; Stets & Burke, 2003), offers a potential explanation for this finding. Fatherhood responsibilities are seen as distant from men's careers, and thus being a father is thought to have a minimal impact on their work (Ayre et al., 2013; Hodges & Park, 2013; Watts, 2009). The opposite assumption is made of women, and as a result, women in engineering are often seen by their colleagues as less dedicated or committed to their work than men (Ayre et al., 2013; Watts, 2009). In an effort to overcome this perception, women may have learned to hold salient an identity at work that does not include their identities

outside of work, a separation that does not seem to be felt by men. It is likely that during the interviews an engineering or work identity was salient for most participants as they were asked about their experiences in engineering. As such, women's personal identities likely were discussed less frequently as they were not part of the salient identity during the interview. This type of tension between identities is likely a challenge for many individuals as they have to negotiate and manage their identities depending on the context.

Only one participant talked about how she managed her identities, saying at work she puts on an "engineering hat," which reminds her not to take things personally, and removes this hat when she gets home. This persisting woman appeared to be using the role swapping strategy demonstrated by men and women engineers in Hatmaker (2012), as she changed which identity was most salient depending on the situation or context. Swapping identities to enact the one most appropriate for the context was not stressful for this persisting woman or those in Hatmaker's (2012) study, but did appear to be problematic for several persisting women, making them hesitant to tell others they were engineers. Several persisting women in this investigation personally identified as engineers but were hesitant to say what they do for a living when outside of work, mainly because people treated them differently or reacted by saying they must be smart. As a result, some women did not tell people they were engineers, even though this was a significant part of how they viewed themselves. It appeared these women withheld information about their work as a form of impression management, as they seemed intentional about the identity they did not want to be associated with outside of work. Contrary to Hatmaker (2012), no one in this investigation tried to distance themselves from the asocial stereotype of an engineer, or said they did not identify due to this image. Although there were several women, and a few men, who talked about engineers lacking social skills, no participants discussed this as an issue with regards to their identity.



### Factors Related to Persistence

Past research has focused on why women leave engineering and only in the last few years has attention been paid to why they stay (Ayre et al., 2013; Buse, 2009; Buse et al., 2013). Even less research has been done on men's retention in the field. Consequently, little is known about the factors that lead to persistence within the engineering population, especially for those who work in industry. This component of the investigation sought to fill this gap by assessing the factors that encouraged persisting engineers to stay in the field, which is part of the fourth research question. In addition, connections between professional identity and the retention themes will be discussed as they arise to answer the fifth research question.

As seen in Table 5, men and women gave the same top two reasons for staying in engineering. However, for men, these reasons were tied in frequency, while for women, the most common reason given for their persistence was enjoyment of engineering work. Although men and women gave the same top two reasons for persisting in engineering, there were some slight differences in their explanations of why each was important to them.

Table 5

*Rankings of the Frequency Factors were cited by Persisters for Staying in Engineering by Gender*

Persisting Men	Persisting Women
<b>1a. Enjoyment of engineering work</b>	<b>1. Enjoyment of engineering work</b>
<b>1b. Money</b>	<b>2. Money</b>
2. Good companies & opportunities	3. Work-life balance

*Note.* Numbers followed by a letter indicate a tie in frequency. Themes in bold were found in both men and women.

**Enjoyment of engineering work.** The most common reason both men and women said they continue to persist in engineering is their enjoyment and interest in the work they do. A number of participants in both genders said they intend to stay in engineering their entire career because of their enjoyment of what they do and the projects they have the opportunity to work on.

This engagement in engineering work has been found in past research as well (Bastalich, Franzway, Gill, Mills, & Sharpwith, 2007; Buse & Bilimoria, 2014), and 75% of women engineers in Hewlett et al. (2008) reported they love their work. Several women in the present investigation commented they value the variety in their jobs and the fact they do not do the same thing every day. Consistent with past research (Buse, 2009; Buse et al., 2013; Buse & Billimoria, 2014), these women enjoyed the challenge and novelty involved in their jobs, as well as the alignment of their work with their interests. Moreover, Hewlett et al. (2008) found that 77% of female engineers find their work intellectually challenging and stimulating. Men and women were both found by Gill et al. (2008) to value the challenges of engineering work, which is consistent with this investigation. Another aspect of engineering that influenced both genders' enjoyment of their work was the opportunity for continuous learning due to the endless advancements in technology.

The participants in this category described positive feelings towards their work that reflected Macey and Schneider's (2008) concept of psychological state engagement. This type of engagement is associated with high involvement and passion in one's work, enthusiasm, as well as commitment and identity in one's work and the organization (Macey & Schneider, 2008). In their framework of employee engagement, Macey and Schneider noted there were several factors related to the nature of the work which have a direct effect on psychological state engagement including variety and challenge, both of which were listed by participants in this investigation. Buse and Bilimoria (2014) found that engagement in work causes women to persist in engineering. A similar relationship appeared to exist in the present investigation as well as both women and men who were engaged in their work and enjoyed what they were doing often said they had no intentions of leaving the field. Furthermore, there appeared to be a link between engagement in engineering work and identity as all participants in this study who said they stayed because they enjoyed the work also identified as engineers. Thus, it appears that engaging jobs could have a significant influence on retention for

both men and women, and facilitate identification, reducing the chances these individuals will leave the field in the future.

**Money.** Money was tied with enjoyment of engineering work for persisting men as the most important factor that encouraged them to stay in engineering, and the second most commonly listed reason for persisting women. For some, simply earning a consistent paycheck or feeling they were well compensated was enough for them to continue in engineering. Others, however, had families who relied on their income. Several of the women commented that they were the primary or equal earners in their families. Many of these women said they liked contributing financially and saw it as a way to help their family and share responsibilities with their spouse. Men also tended to talk about engineering as a way of providing for their family, yet none talked about it as a partnership or discussed what their spouse contributed like several women did. For men, there was a focus on what they, individually, provided for their families, with several valuing they earned enough their wives could stay home and not have to work. This difference in how men and women talked about contributing financially to their families likely stems from traditional American gender roles in which men are expected to act as the primary providers (Hearn & Morgan, 2014). In addition, this difference may indicate women who persist in engineering possess less traditional gender roles than men in the same field.

**Work-life balance.** For several women, but none of the men, being able to achieve work-life balance was a significant factor that affected their intentions to persist in engineering. These women said they valued their families as well as their work as an engineer, and attributed their persistence to the fact they had been able to balance both. Most of these women had been proactive about taking steps that enabled them to find balance as it was not necessarily something that came easily. Those who were able to achieve work-life balance were often intentional about finding engineering jobs or companies that would allow them to work flexible or part-time schedules. Most

participants who made efforts to stay in engineering also identified with the profession, and thus, likely made adaptations as a way of maintaining membership in this group.

Two women in this study specifically said they stayed with their company because they allowed them to work a modified schedule, and many talked about their companies being supportive of work-life balance and offering good work-life benefits. This type of intentionality about finding a company that allows them to work a schedule conducive to work-life balance is consistent with findings from Ayre et al. (2013) who found half the women engineers in their study choose their organization mainly due to the family-friendly policies they offered. Fouad and Singh (2011) emphasize that simply offering family-friendly benefits is insufficient to facilitate persistence; companies and managers also have to support their use and be accommodating to employees' lives outside of work (Fouad et al., 2012).

Not only did the company and their work-life policies make a difference in work-life balance for women persisters, those whose husbands partnered with them in sharing family responsibilities significantly influenced their ability to persist in the field. Several women talked about how they share parenting and family duties with their spouse, without which, they do not feel they could continue working. The couples who used this approach worked together as a team to establish balance for their family. Women gave examples of duties their husbands have taken on such as driving their children to daycare and doctor's appointments or having dinner on the table when they come home. One woman said if she had to work late her husband would pick their kids up from school, feed them dinner and put them to bed. Having this type of support and teamwork from their spouse enabled several women to feel they could work and be a mom without having to sacrifice either of these roles. In contrast with these findings, Buse et al. (2013) found no effect of husband or partner support on persistence. While in the present study there were only a few women

who talked about the impact of spousal support on their ability to persist, for these women, it made the difference between them being able to persist in the field and having to leave.

**Good companies and opportunities.** Two male persisters said they stay in engineering because they have good jobs and like the companies they work for. Both valued the experience they were gaining in their organizations through the challenging assignments and opportunities they had been given. One of these individuals also talked about liking the company itself, commenting they are family-oriented, offer great benefits, and that he likes the people. None of the persisting women said they stayed in engineering because of the opportunities at their companies, although some did say they stayed because of the work-life policies offered by their organization.

**Summary of factors related to persistence.** Persisting men and women cited the same main two reasons they stay in the field; enjoyment of engineering work and money. An interesting finding however, was that for men, these two factors were cited with equal frequency, while for women, double the number said they stayed for enjoyment of the work than money. This may indicate that men see their earning potential as equal to or more important than enjoying what they do. This view likely stems from traditional gender roles which may shape each gender's beliefs and priorities with regards to work. Furthermore, a connection between identity and retention was also found for both men and women as all participants who said they persisted because they enjoyed engineering work also identified as engineers. Thus, there appeared to be a connection between engagement with engineering work and identity.

The only difference found between men and women was on the third most commonly cited reason they stay, with men persisting because they work for good companies that give them opportunities and valued benefits, while for women, the achievement of work-life balance encouraged them to stay. It is noteworthy, considering the extensive writings about the culture of engineering which make men and women sound like opposites (Hewlett et al., 2008; McIlwee &

Robinson, 1992), that the two factors that most affected intentions to persist were the same for both men and women. This likely indicates there may not be as great of a difference between men and women engineers as has been previously thought. Despite the fact male engineers have been, for all intents and purposes, unstudied with regards to retention, the finding that they stay for the same reasons as women should not come as much of a surprise. It makes sense that people within the same field would be engaged and interested in similar things. This finding, however, does highlight the need to study men as there are likely many more similarities between men and women in this field. If we continue to focus on women, at the exclusion of men, we are bound to maintain the unwarranted perception that men and women are two disparate populations trying to operate in the same environment.

Furthermore, if men and women stay for the same reasons, interventions to improve these aspects may affect retention for engineers in general, which would be of great benefit to the field overall. Since most past studies have only assessed women, their suggestions focus solely on improving the workplace to make it a better fit for this one small group. However, if we find that changes would increase persistence for engineers in general, companies may be more likely to implement them as they would have an effect on a significantly greater percentage of their workers. In addition, moving away from focusing on these changes as a way to retain women, which gives the impression these issues are only relevant to them, may mitigate the perception it is women, not the environment, culture in engineering, or other factors, that are the problem.

### **Factors Related to Leaving Engineering**

To answer the second half of the fourth research question, the reasons non-persisting men and women have left engineering, as well as the factors persisting men and women feel may encourage them to leave the field, were considered in this piece of the investigation. The purpose of assessing the factors that encourage turnover was to better understand the high dropout rates in the

field and the factors that contribute to them. According to Frehill (2012), most engineers leave the field within 10 years of earning their degree. Although the rate at which women leave is much sharper than men (Frehill, 2012), this concentration of attrition in the early years is problematic for the field in general and a threat to the high demands for these workers. The following themes reflect the factors non-persisters identified as influences on their decisions to leave the field, as well as the factors that have made persisters consider leaving engineering. Table 6 shows rankings of the frequency each theme was cited within the four participant groups. Any themes connected to professional identity will be discussed to address the fifth research question.

Table 6

*Rankings of the Reasons Participants Have Left or Consider Leaving Engineering by Participant Group*

Persisters		Non-Persisters	
Men	Women	Men	Women
<b>1a. Work-life balance</b>	<b>1. Work-life balance</b>	<b>1a. Competing interests</b>	<b>1. Competing interests</b>
<b>1b. Competing interests</b>	2. Discrimination	1b. Career development	<b>2. Children<sup>a</sup></b>
<b>2. Mismatch in values</b>	<b>3. Mismatch in values</b>	<b>2a. Work-life balance</b>	3. Discrimination
	4. Challenges with coworkers	2b. Money	
	5. Isolation	2c. Too much interaction	

*Note.* Numbers followed by a letter indicate a tie in frequency. Themes in bold were found in both men and women.

<sup>a</sup>Part of the work-life balance theme

**Work-life balance/children.** Balance between work and family life was the only retention factor that arose in all four groups as a reason participants had considered leaving or had left engineering. Despite the emphasis in the literature on work-life balance being a women's issue, in this study it was the most common factor both male and female persisters said would push them away from engineering. One of the challenges associated with work-life balance for a few female

persisters was the stressful and mentally demanding nature of the job, which often left them with little energy for things outside of work. In addition, persisting women and both groups of men talked about the long hours common in engineering and the time it takes away from their personal lives and families. This appeared to not only be an issue for participants working in industry, but for those in academia as well. Long work hours are a hallmark of this field which make it difficult for many engineers to find balance with their lives outside of work (Hewlett et al., 2008; Fouad et al., 2012). Past research on women in engineering (Hewlett et al., 2008) reported 74% felt pressure to put in extensive time at the office, compared to only 19% in all other sectors. The demand for face time disproportionately affects women as they are typically the primary caregivers (Hearn & Morgan, 2014; Watts, 2009), and therefore bear the brunt of family responsibilities.

In the largest study to date on men's and women's attrition from engineering, Frehill (2007) found that 63.2% of women said they left the field due to family-related reason compared to only 9.7% of men, representing an extremely large gender gap. In addition, women are more likely than men to think about their career in terms of how it affects others and make career decisions based on the impact of their choices on others (Buse et al., 2013; Mainiero & Sullivan, 2005). This appeared to be true in this study as well, as several women, but only one man, talked about making career decisions with others in mind. One male persister was fine working long hours until he had kids, which shifted his values and led him to move to a division of his company that did not involve engineering because it required fewer hours. He also began leaving by six every night to be home for dinner and no longer worked weekends.

Female persisters also made adaptations to facilitate work-life balance. Some women had conversations with their bosses about their desire to work part-time after having children to see if they were open to the idea and to ensure doing so would not affect their career progression. Those who engaged in these conversations said that had their company or boss been unwilling to work



with them as they tried to create work-life balance, they would have left the organization in search for one where these needs would be met. One woman explained she watched the challenges women in leadership roles at her company faced and the limited time they had with their children due to the demands of their jobs. Seeing this encouraged her to pursue engineering jobs in other companies, rather than trying to progress in her current organization, as she wanted more time with her kids. This woman's observations of female role models in the organization, who held the types of leadership positions she was aspiring to obtain in the future, allowed her to identify what Ibarra (1999) refers to as a feared self, or a person one does not want to become. This experience made it evident to the woman she could not have both the career and the family she wanted if she stayed in her current organization. Rather than sacrifice her identity as a mom or a leader, she sought employment with a different engineering company that was not as demanding, as she believed she could find an organization that would enable her to be both.

Past research has found that in engineering, career advancement tends to involve increasingly demanding jobs and many women simply do not see how they could balance both work and family (Hewlett et al., 2008), often forcing them to choose between the two (Buse, 2009). In this study however, the demands of engineering did not seem to make women feel they had to choose one over the other. Most women took measures such as changing companies to allow them to progress in their career and still have time for family. Several of the persisting women, and one persisting man, who made adaptations to enable them to persist, also identified as engineers. This may suggest identification with engineering motivates people to continue working in the field and to remove barriers that may prevent them from doing so. Thus, identification appears to have an influence on retention as it encourages people to exert effort in order to continue their group membership.

With regards to work-life balance, non-persisting women who fell into this theme differed from the other three groups in that all four women had left at least partially because they wanted to be stay-at-home moms. Two of the non-persisting women said they had planned to be stay-at-home moms, with one saying she had always planned to do so, and therefore knew she would not work in engineering long-term. The other two intended to return to work, but realized after their children were born that they wanted to stay home and care for them. Evidence of Buse et al.'s (2013) finding that non-persisting women expressed concern over their ability to balance work and family was only somewhat seen in one non-persisting women. This individual left partially because childcare was harder to manage after having a second child, but she maintains that her decision was largely due to her dissatisfaction with her job, which had changed shortly before she left. According to this woman, she would have found a way to make childcare work had she still liked her job. Non-persisting women in this study who left to care for their children, typically did so due to a personal desire to be a stay-at-home mom, not because of doubts they could do both or dissatisfaction with engineering. Similarly, two persisting women expressed a desire to stay home with their children and said they would consider leaving engineering to do so if the opportunity arose.

According to Fouad and Singh (2011), women who work in organizations with cultures that support work-life balance and offer policies to facilitate their ability to do both experience less work-life conflict. Fouad (2014) emphasized however, that in order to attract and retain employees, an organization must have both a culture that supports work-life balance, and provide benefits that aid employees in finding balance, as either alone is insufficient. In addition, Fouad and Singh (2011) found that women were more committed to the profession of engineering when employed by an organization that did not impose excessive demands on their time. This finding provides evidence that factors at the level of the organization can have implications on one's commitment at the level of the profession, where retention is most problematic for women in engineering.

**Competing interests.** The only participant group where competing interests was not a factor in retention was persisting women. Competing interests were the most common reason both male and female non-persisters left the field as they wanted to pursue interests outside of engineering. For a few male non-persisters, this interest was discovered before choosing engineering as a major, like the individual who chose to major in engineering but had always planned to become a pilot. More commonly though, people discovered an interest or passion for something other than engineering. Several male and female non-persisters chose to pursue work outside engineering after discovering other interests, such as the two women who discovered a passion for teaching or the individual who realized he wanted to work in the non-profit sector. A couple of non-persisting women said they had a variety of interests and left engineering to explore them, but did not specify what those interests were. Individuals who left the field to pursue a competing interest tended to point out that they did not dislike engineering or lose interest in the subject, but had something else they wanted to explore.

Two other non-persisting women explained their departure from the field by contrasting themselves from men they felt were “real” engineers. The examples they gave of men they considered “real” engineers were highly prototypical in that these men liked figuring out how things worked and taking things apart. Although both women did consider themselves engineers, they felt real engineers did not have interests outside of engineering, and the fact they did have other interests limited how much of an engineer they were. The lack of similarity they perceived between the prototype of an engineer and their interests seemed to make these women feel their decision to leave engineering was a logical choice. The feeling one is not a full group member can be damaging not only to an individual’s identity but also their intentions to persist in the field, as it was for these women.

All but one male persister who had considered leaving engineering to pursue a competing interest differed somewhat from the non-persisters in that they thought about pursuing a new interest or skill for the challenge or opportunity doing so would present. One participant said he had considered pursuing sales and business because it would challenge him, while another had thought about leaving for a job where he could use his people skills. Participants like these may have been retained in engineering if their job responsibilities included greater diversity as they may have been able to find the challenge they were looking for, or the opportunity to use a broader range of skills, within engineering. Rather than organizations offering engineers the option of a strict technical or management track, it may be advantageous to also offer positions which combine the two. Especially in engineering organizations where the individuals making decisions can often benefit from the possession of in-depth technical knowledge about a project, separating these two roles may not always be an effective strategy. While there are often different skillsets or strengths that make individuals successful in a management versus a technical role, there are many who possess skills in both. As a result, making individuals choose one path or the other may unnecessarily drive talent out of the field.

A change in career or professional interests was found by Frehill (2008; 2012) to be the most common reason women left engineering. This was also the case for the non-persisting women in this investigation, as this was the most frequently cited reason for their departure. Frehill (2012) also found that 19% of men listed a change in career or professional interests in the top two reasons they have left the field, indicating this is an important retention factor for both men and women. Fouad and Singh (2011) found that a common attribution women made for their departure was their discovery of interest in a field outside of engineering or that they lost interest in engineering. While many participants in this investigation did attribute their departure to their development of another interest, none expressed they lost interest in engineering.

**Discrimination/poor treatment based on gender.** The issue of the gender disparity in the field arose in many of the women's interviews, as well as discussions of the discrimination and poor treatment some encountered because of their gender. None of the men discussed experiencing any issues related to their gender. While gender was frequently brought up by both persisting and non-persisting women, it was more commonly discussed by the non-persisters, with all but two talking about some aspect of gender in the workplace. Most however did not talk about gender as a problem, they simply talked about there being a noticeable gender gap in engineering. Consistent with this investigation, Buse et al. (2013) found both persisting and non-persisting women experience challenges related to gender. A surprising finding in the present investigation, considering the frequency with which gender issues were discussed and the number of studies on women in engineering that have attributed their departure from the field to the culture (Ayre et al., 2013; Buse, 2009; Buse et al., 2013; Fouad & Singh, 2011; Hewlett et al., 2008), was that only two women left the field due to discrimination or poor treatment based on their gender, and only four said this might make them leave in the future.

Persisting women talked about the presence of "good ol' boy clubs" and feeling that men do not see them as competent because of their gender. The presence of "good ol' boy clubs" have been reported by 52% of women in engineering (Hewlett et al., 2008), which contribute to the feeling many women have about the need to prove themselves, and the difficulty of moving up in the organization. Women in this study said they feel they have to prove their competence, as it is not a given, like it tends to be for men in engineering. These women seemed to be facing the (in)visibility problem described by Faulkner (2007), in which they are seen by their gender, and therefore not seen as engineers, something that does not occur for men. These findings align with research on the identities of stigmatized groups being reduced to single dimensions (Prasad et al., 2007), as the women in this investigation were seen as women first, and engineers, only if they

proved it. In addition, Faulkner (2009b) notes that women have to continually re-establish their competence when they work with or encounter new people in the workplace throughout their entire careers (Faulkner, 2014), making this a constant battle women in engineering have to endure.

The culture of engineering and the male-dominated nature of many engineering workplaces can make it an uncomfortable or difficult environment for women to work. Some women felt they were treated differently because of their gender, giving examples such as men not looking at them during conversations, only looking at other men, or making them prove their competence. One woman said when she returned for her second summer internship with a company, the women's restroom in her building had been turned into a men's room because the company employed so few women. She now had to walk across the parking lot to another building to use the restroom. Women in both groups talked about the presence of pinups or "girly posters" on the office walls, which was also reported by Gill et al. (2008). Others endured sexist and offensive comments from leaders, coworkers, and clients. Sexual harassment is problematic in engineering with 69% of women reporting being the victim of harassment, compared to 63% in SET (science, engineering, and technology) fields in general (Hewlett et al., 2008).

A few women reported being asked illegal interview questions such as whether they were comfortable working with men or if they planned to have children. One woman, who was also an ethnic minority, became so tired of being asked these types of questions on the job and in interviews, she left engineering and strongly discouraged her son from entering the field because of her experience. Women in Gill et al. (2008) also left the field because they were tired of fighting their gender in engineering. Women in Hatmaker (2013) who encountered illegal interview questions used rationalization strategies as a coping mechanism to make "sense of the situation to convince themselves they were 'okay' with it" (p. 390). Engaging in rationalization enabled the women to move on from the situation and persist in the field. Conversely, the woman in this study

who left after encountering similar situations did not adopt any such strategy. While discriminatory behaviors and interview questions should not be tolerated, women in Hatmaker (2013) said they chose to let things go because they did not want to create issues and wanted to work in engineering. Due to the long history of male domination of the field, it is likely that even though an organization may generally be friendly to women, there may still be a number of individuals who are not open to women's participation in the field or who act in ways that make women feel uncomfortable. Women may engage in rationalization strategies acknowledging it is unlikely everyone in the company will marginalize them or make sexist comments, so they choose to ignore certain behaviors or interactions to allow themselves to work in a field they enjoy.

The response of the woman described above, who left engineering and discouraged her son from pursuing work in the field, was similar to the way minority students experiencing belonging uncertainty in Walton and Cohen (2007) discouraged members of their minority group from entering the same field of study. This woman's discouragement of others entering engineering due to her poor experiences may also occur in others as well, highlighting the negative effects of poor experiences, not only on the individual, but other minority group members as well.

**Mismatch in values.** A mismatch in values was cited as a factor in retention for male and female persisters, but not non-persisters. The main value conflict that was described related to the prevalence of military work in engineering. Two men said they have considered leaving engineering to avoid working on military projects due to their beliefs about war, and one woman had left her job for this reason. Both men talked about the prevalence of military work in the field of engineering and therefore, the difficulty of avoiding working for a defense contractor. Others, including Blue, Levine, and Nieuwma (2013), have also noted the pervasiveness of military work in engineering, citing the government's spending on research and development related to defense, as well as the extent of federal funding allocated to defense research in engineering.

Women in this study who felt a conflict between their values and military work either did not take jobs with defense contractors in the first place, or they left the job for one within engineering that did not involve defense work. One woman who left her job with a defense contractor due to her beliefs, did so after a trip to Africa, which put into perspective the amount the US government spent on defense, and how much good that money could do to help people in need. The cognitive dissonance produced by this realization motivated her to leave her job for another within engineering that did not involve military work (Elliot & Devine, 1994; Festinger, 1962). While this woman left a company and a job she felt conflicted with her values, she did not feel the need to leave engineering to avoid this conflict.

In contrast, the two male persisters who expressed their dissatisfaction with engineering's entanglement with war felt strongly enough they may leave the field in the future to avoid it. The cognitive dissonance that arose for these men between their beliefs about war and the prevalence of defense work in the field motivated them to choose jobs with less dissonance. One man took a job where the military involvement was minimal, and the other said he accepted the lower paying of two job offers, as the higher offer was for a company that made bombs. This individual also pointed out his company does not make lethal weapons and his project actually prevents civilian casualties. The level of distress caused by cognitive dissonance varies with the number of elements in conflict and the importance of those elements (Aronson, 1999; Festinger, 1962). Both of these individuals seemed to have chosen roles with an acceptable level of dissonance for them, but eventually may leave to avoid this dissonance completely.

Conflict between one's personal values and defense work in engineering was not found to influence retention in other research with this population, but should be investigated further to evaluate whether it is a factor pushing others away from engineering as well. If the involvement with war does appear to be a deterrent, educators could emphasize engineering jobs that do not



involve defense work to engineering students to broaden their perceptions of their options within the field. This may prevent people from leaving engineering during college or exiting the field due to perceptions they cannot avoid the value conflict involved in defense work as an engineer.

A mismatch in values was also seen for two persisting women in relation to the organizations they worked for. The woman described above, who left her job due to conflicting values with the government's spending on defense, also experienced a mismatch in values with the company she went to work for. Over time she learned the new company was not truly green or concerned with the environment, but said they were to win contracts. This made her want to leave the organization as she did not want to be part of this dishonesty. For another persisting woman, the way her company handled a situation in which she was harassed on an overseas assignment made her leave the company. The company's response to her experience was they would never again send a woman to work on a similar assignment because it was too much trouble. This response highlighted a mismatch between her values and the culture of the organization, and she did not feel she could change the culture to make it a place she wanted to work.

Similar to the individuals in this group, Edwards and Cable (2009) found a lack of congruence between the values of an employee, which are a component of their identity, and the values of their organization, can increase turnover intentions. Both of the women who discussed this issue left their organizations to avoid this conflict, but planned to stay in engineering, while the men considered leaving engineering entirely. This suggests a lack of value congruence may encourage turnover from the organization as well as the field.

**Isolation.** Isolation was only an issue related to retention for two persisting women. Both women were either significantly outnumbered by men in their jobs or the only woman. One said she was the only woman in her group for a long time, and almost left because of how lonely she was. Fortunately, before she made the decision to leave, another woman was added to her team,

which encouraged her to stay. In accordance with past research, women in this study found being outnumbered isolating (Ayre et al., 2013; Bastalich et al., 2007). A few women talked about how excited they felt when women were added to their teams, which appeared to be a rare event. Some past studies have found that women avoid or distance themselves from other women at work (Hewlett et al., 2008), which can increase isolation (Buse, 2009). No evidence of this type of avoidance was found in this investigation although the women did not appear to make much effort to get to know other women at work either.

Both women who considered leaving engineering due to feeling isolated also expressed frustration that they were not invited to lunch or activities with their team despite the fact all the men in their group went together. In addition to being a minority because of their gender, both of these women also struggled with the fact they were much younger than most of the men they worked with, and thus, also felt like minorities because of their age. The feeling they were a double minority compounded the isolation and made it even harder for them to feel part of the group. Both women commented they felt the older men did not know how to interact with them, with one acknowledging the men with daughters her age were better at talking to her, but even they did not include her or invite her to lunch with the group. Hewlett et al. (2008) found that nearly half of women in engineering report extreme isolation. Isolation has been found to lead to job dissatisfaction and a 22% increase in turnover in women in engineering (Hewlett et al., 2008), indicating this is a significant issue faced by women in this industry. Isolation did not appear to be as widespread of an issue in this investigation but it was extremely problematic for those who experienced it.

**Too much interaction.** One male non-persister, who never worked as an engineer after earning his degree, said he did not seek engineering employment partially because he underestimated the extent of interaction involved in engineering. This individual felt there was a disconnect

between the amount of interaction he encountered in engineering school and what is required in the field. As a result, he was under the impression he would mostly work alone as an engineer and upon realizing this was untrue, decided not to pursue work in the field. Other participants also discussed their surprise at the amount of interaction engineers engage in and the extent to which they work in teams in practice. Faulkner (2007) found many engineers in her study were surprised by the social nature and content of their jobs, believing they would be heavy in math, due to its emphasis in engineering education. Many of the individuals in the present study said engineering school did not prepare them for the amount of interaction and teamwork that exists in practice, and felt this should have been discussed and integrated into their education to give them a more accurate representation of what they would encounter.

In addition to telling students about the need for interaction in the field, others have also encouraged the integration of communication training (Dannels, Anson, Bullard, & Peretti, 2003) and teamwork (Borrego, Karlin, McNair, & Beddoes, 2013) into engineering curriculum, noting the skill gap engineering graduates have in these areas (Darling & Dannels, 2003). Integrating competencies like these into engineering curriculum may give students more accurate perceptions of the field and set them up for success in more than just the technical aspects of their future jobs.

**Challenges with coworkers.** Two persisting women considered either leaving their jobs or leaving engineering altogether due to challenges with their coworkers, a theme which was not found in men or non-persisting women. Although only two women had considered leaving due to challenges that arose with their coworkers, other men and women also shared stories about the aggressive nature of engineering and the challenges that stem from the culture. One woman gave the example of a male colleague who said in front of a room of people that if she was not smart enough to figure out the problem she was trying to solve, she should not be an engineer. She said situations like that made her question why she was in engineering and made her consider leaving.

Two persisting women described the difficult transition they faced when they started working in engineering and had to adapt to their new team (Ibarra, 1999). These women said they had to learn to not take things personally, explaining they had a hard time with the way men on their teams communicated. Both women said they often felt personally attacked at work and had often come home crying as a result. The husband of one of these women coached her on talking to the men in her group and role-played scenarios with her to help her learn how to communicate with them. He also tried to explain to her what the men meant by their comments to help her understand they were not personal attacks even though they felt that way. Aggressive communication styles have been identified as an aspect of the engineering culture (Bastalich et al., 2007; McIlwee & Robinson, 1992) and can have a significant impact on an individual's desire to work in this environment. Others too have found the culture in engineering to be aggressive and even hostile (Hewlett et al., 2008). Some evidence exists that engineering workplaces are not only difficult for women, but for men as well, although there are few studies which have assessed this in men. Frehill (2009) found 5% of male engineers left the field due to the negative work climate and according to Mills et al. (2008) 19% of Australian male engineers reported workplace bullying. While these types of issues and aggressive communication styles do not always drive people out of engineering, they do seem to create environments people say are not nice places to work and have the potential to push them away from the field.

**Career development and money.** Male non-persisters were the only group who said they left engineering to progress in their careers or make more money. Three men who left to develop their careers went into management roles but stayed within engineering companies. One man said he went into management because he wanted to gain more control over the work than engineers tend to have. The other two saw their decision to step away from traditional engineering work and into management as a way to move up in their careers. Past research (Frehill, 2012; Mills et al.,

2008) has acknowledged that in order to earn more and progress in their career, engineers often have to leave a technical track and go into management. Intriguingly, all three men identified themselves as non-persisters on the survey, but two still work in management roles for engineering firms, and all three men identified themselves as engineers in their interviews. This may indicate the move into management made them feel they were no longer engineers, despite their personal attachment or identification with engineering.

This tendency to not see management as “real” engineering work has also been found by Faulkner (2007) who noted that several participants who moved into management felt in doing so they were stepping away from engineering. Faulkner (2014) reported that women in senior management roles said they introduce themselves as managers, whereas their male colleagues in the same position continue to call themselves engineers. Faulkner’s findings may say something about the nature of engineering being gender-consistent for men, likely making it easier for them to identify as engineers in the first place, and to maintain that identity, even after leaving. However, in this investigation, several men and women made comments about not considering themselves engineers anymore because they are in management roles, or marked themselves as non-persisters on the survey, indicating this tendency may not be unique to women.

One male non-persister left engineering after finding he could make more money as a technician. Although he acknowledged working as a technician required less education and skill than engineering, he explained he had gone into engineering for the money so when he found he could earn more elsewhere, he decided to leave. Frehill (2012) found the most common reason men left the field was for pay or promotion opportunities (27%). This was tied in this study with competing interests for non-persisting men.

**Summary of factors related to leaving.** A variety of factors have been identified in past literature as reasons women and men leave engineering. Several of these factors were found in this

study as well, in addition to the discovery of a few factors that have not been discussed in previous work. While there have been several large-scale studies on retention in women engineers, insufficient attention has been paid to retention in men. This study sought to fill this gap by offering an examination of the factors influencing turnover in male and female engineers to provide a more holistic view of the engineering population.

Work-life balance and competing interests were the most commonly discussed factors related to attrition from the field, and were found in both men and women. Work-life balance, or the desire to stay home with children, was found to be an issue in all four groups and competing interests were discussed by all groups with the exception of women persisters. Most participants who discussed challenges with work-life balance felt the long hours expected of engineers detracted too much time from their lives outside of work. In contrast, the non-persisting women who left to be stay-at-home moms did so because of a personal desire to raise their children, not due to frustration with the hours. Identity appeared to play a role in retention as several of those who identified with engineering made adaptations that allowed them to stay in the field. These individuals seemed motivated to stay in engineering and took steps to allow them to do so.

There appeared to be a degree of overlap between the male persisters who left to pursue competing interests and male non-persisters who left for career development. Individuals in both of these groups mainly seemed to be looking for more of a challenge than they had in their current jobs and most wanted to progress in their careers. Participants in both groups talked about their desire to step into management roles or use these types of skills. In contrast, male and female non-persisters who left due to competing interests did so to fulfill an outside interest, but were much less likely to talk about their departure in terms of career development. The individuals who left due to a personal interest that did not involve engineering are ones who would be difficult to retain in the field. However, those who left more for the purpose of progressing in their career, whether that be

by leaving engineering or stepping into management roles, are a population with a high potential for being retained. For the most part, these individuals felt they had to leave engineering to progress in their career or use their non-technical skills. Organizations that create additional career options for engineers so they do not have to opt for a strict technical or managerial track, but a combination of the two, may be able to retain individuals like these.

In addition, changing the prototype of what engineers do and incorporating management into this definition, may enable individuals to see potential for career progression within engineering, and prevent turnover. Working in management appeared to pose a threat to identity as it made some men and women feel they were no longer engineers. This tendency to perceive oneself as leaving engineering when moving into a management role, or as someone who used to be an engineer, in the case of one who now works as a manager, suggests identity can be problematic for those in these roles. This idea of redefining engineering will be discussed in more depth in the future research section.

Three factors appeared to only affect turnover in women including (a) discrimination and poor treatment based on gender, (b) isolation, and (c) challenges with coworkers. All three of these factors appeared to relate to the culture of engineering and women's minority status in the field. While not an issue for all women, gender did appear to cause problems for a large number, which men in the field did not have to face. Several women discussed the challenges associated with being a woman in a heavily male-dominated field, and the range of negative behaviors they encountered as a result, ranging from being treated differently to blatant discrimination. These types of interactions seemed to make the workplace a challenging and lonely place, however, only two women felt the problems were severe enough they left the field. Other women have persisted thus far, but have considered leaving to avoid these types of experiences in the future.

In contrast to women's feelings of isolation in the workplace, one man did not like how much interaction was involved in engineering and decided to not pursue a job in the field as a result. This individual felt misled about the nature of engineering work and likely would have benefitted from a more accurate portrayal of engineering in school. With a more realistic perception of engineering, he likely could have decided whether or not the field was a good fit for him during college and changed his major, rather than earning the degree and never using it.

The final theme identified as a factor related to turnover in the field was a mismatch in values which was discussed by male and female persisters. The main value conflict that arose in both groups was the prevalence of defense work in engineering, which appeared counter to the values and identities of several participants. Women who did not want to be involved in military work often talked about thinking about this prior to taking a job, and did not accept positions with companies they felt conflicted with their personal values. In contrast, two of the persisting men took jobs with defense contractors despite their beliefs about war, but opted for ones that minimized the cognitive dissonance they felt. While there was intentionality demonstrated by these men in selecting their jobs, they still took positions that conflicted with their values, and unlike women, felt they needed to leave the field in order to avoid military involvement. Thus, a mismatch for men was a force to consider leaving engineering, whereas for women, it was a force to leave a job. Redefinition of engineering to incorporate the diversity of jobs and projects engineers work on may prevent individuals like these from feeling the need to leave the field in order to avoid this conflict. Figure 2 provides a model which illustrates the connections found in this investigation between identity and the factors that encourage people to stay in or leave the field of engineering.



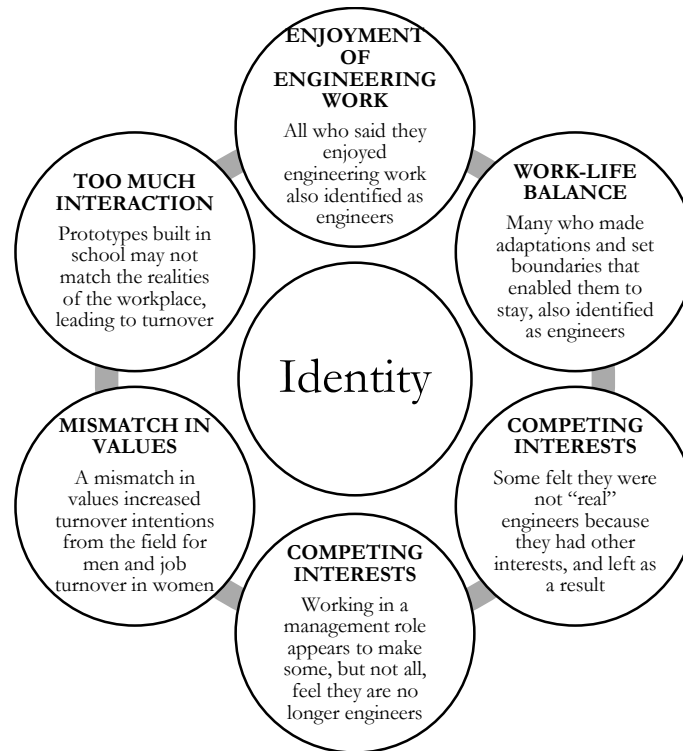


Figure 2. Retention Factors Influenced by Identity.

An important implication from past research is critical to consider with regards to retention in the field of engineering. Fouad and Singh (2011) found that women's intentions to leave the organization they work for appear to be highly related to their desire to leave the field of engineering as well. This indicates that women who intend to leave their organizations are also at risk for leaving engineering. Blau (2007) found some differences in the antecedents of organizational and occupational turnover, yet these findings highlight the importance of thinking both at the level of the organization, as well as the level of the profession, when addressing retention in engineering. Individuals in this investigation made career changes at the job and organization level, however, only a few organization changes were noted in the discussion due to the focus in this study on retention at the level of the field.

**Limitations**

There are a few limitations that should be considered when evaluating the findings of this investigation. First, the majority of individuals who responded to the survey lived in the Seattle area which limited the geographical diversity of the sample. As a result, the findings may not be representative of a national sample if there were factors unique to that location. In addition, due to the focus on Christian faith in the original study, interview participants were oversampled to obtain a large number of Christians for the analysis. Thus, the interview sample may include a larger proportion of Christians than would be found in a general sample of engineers. This may have influenced the findings if Christian engineers differ from engineers of other faiths or non-faith backgrounds. Another potential limitation is the fact the measures were self-reported and largely retrospective, which can result in inaccurate reporting. Furthermore, both persisters with low identity scores and non-persisters with high identity scores were oversampled for participation in the interviews, which may have influenced the findings as those who participated may have had more extreme experiences or feelings about these issues than the general engineering population. Despite these limitations, this study offers a valuable examination of a large number of men and women with engineering degrees, and contributes to our understanding of identity and retention in this population.

**Future Research**

A crucial finding that emerged in this investigation is the importance of alignment between perceptions of engineering and the realities of practice. Several issues arose as a result of significant disparities between what people believed about engineering, the prototypes they had been exposed to, and the realities of the workplaces they entered. These misunderstandings were most commonly related to what engineers do, who engineers are, and the importance of interaction and communication in engineering. While a lack of alignment between reality and an individual's

expectations did not always lead to the person leaving, many expressed frustration or disappointment with what they found in the field. It is also likely that many choose to not pursue an engineering degree as the result of false beliefs about what engineering is due to stereotypes of the field, which appear to be highly resistant to change or contrary evidence. The current prototype of an engineer is far too restrictive considering the breadth of opportunities, roles, and skills used and needed in the field. Consequently, people seem to have an overly narrow definition of what constitutes engineering work, which marginalizes many important roles, including engineering managers and professors, and makes it difficult for many to identify as an engineer.

Future research should examine the field of engineering with the goal of conceptualizing the variety of roles and industries engineers work, as well as the skills and competencies needed to operate effectively in the profession. It is crucial to conduct research on the field of engineering to better understand current realities, and to communicate those findings to engineering professors, who are a main source of students' knowledge about industry and practice. Information that accurately reflects the realities of engineering is especially important for students to hear during college as this is a critical time for professional identity development. As a result, Stevens, Joshi and O'Connor (2014) suggest engineering faculty should talk about the field in a way that is consistent with research on engineering practice, as few faculty have experience in industry and are likely communicating inaccurate portrayals to students based on their own faulty prototypes. If students are exposed to inaccurate examples of what they are likely to encounter in the field, they may form a sense of professional identity and a prototype that does not fit what they find upon entering the workforce. This may result in a threat to their professional identity and cause them to question their fit or leave the field (Stevens et al., 2014).

One specific area that should be focused on in these investigations, and emphasized by professors, is the level of interaction engaged in by practicing engineers. Integrating messages into

engineering education about the interactive nature of the field, and the importance of communication skills, may result in several positive outcomes. The first is it may help broaden the definition of an engineer, which currently labels individuals with social skills and the ability to communicate, as non-engineers, a tendency Faulkner (2009b) refers to as the social/technical dualism. This is one of the reasons management tends to not be considered engineering, as well as part of why women continue to not be seen as engineers. Second, the number of individuals who are surprised by the level of interaction in the field may be reduced. Most college engineering work is done independently, leading students to believe that working as an engineer will be a solitary activity. Integrating teamwork and communication skills into the classroom will help develop these competencies in students so they graduate with more than just technical skills, and with expectations more in accordance with what they encounter in the field. Finally, accurately portraying the interactive nature of the field may also prevent turnover in those who leave the major due to concerns over a lack of interaction and community in engineering. Thus, those with both technical and social skills may be more likely to enter and persist in the field, providing a valuable skillset the field needs in greater numbers.

Although college appears to be central to professional identity development for engineers, the potential of the workplace in shaping identity should not be overlooked. Organizations can play a role in redefining the prototype of engineering and facilitating identification, especially when employees are new to the company or in transition between roles. It is likely people will experience some degree of identity change during transitions such as these (Ibarra, 1999), presenting prime opportunities for identity development. Consequently, organizations that can help employees feel connected to engineering, the company, the work they are doing, or their workgroup, may facilitate identification and commitment in these individuals. Doing so may not only encourage retention within the company but within the field of engineering

in general. Future research should investigate ways organizations and leaders can effectively establish and facilitate identification in employees. Furthermore, attention should be paid to the time it takes for identities to change so that organizations know when to concentrate efforts for maximum effect. In addition, focus should be placed on determining the level of identification (e.g., one's profession, organization, or workgroup) most influential in retention so that interventions and efforts are targeted at the level with the greatest likelihood for positive outcomes.

Another area in need of further examination, which arose in this study, is the influence of money or income on persistence. Given the frequency with which money was reported in the present investigation as a variable influencing both men's and women's intentions to persist, it is surprising this variable has not arisen in other studies. This may be due to the dearth of research on the reasons engineers stay in the field, which should be evaluated in future investigations. In addition, money should be considered as a type of reward which may influence persistence in engineering as it was found to be highly valued by both men and women in this study. Future work in this area should consider reward structures and strategies that may motivate commitment or other desired organizational outcomes. For example, if an organization is struggling with high turnover due to excessive hours needed to complete a project, they may offer employees overtime pay to compensate them for the extra time they contribute. This may communicate to employees their time investment is acknowledged and appreciated by the company, which may encourage some to persist, while for others, the increase in pay may simply be enough to motivate persistence. Work in this area should seek to determine what strategies are most beneficial in creating a variety of desired outcomes.

Another area in need of further examination that was discussed by several participants in this investigation is how to facilitate women's re-entry into engineering after time away from the field. Several women said, for example, they did not feel they could return to engineering after staying

home with their children for a few years due to the advancements in the field while they were away. Hewlett et al. (2008) report 78% of women in engineering want “on-ramping programs” to help them return to the field, which was higher than the number of women requesting these types of programs in science and technology. Rehiring past employees is advantageous both to the individual as well as the company, as the employee is able to return to a job they enjoy, and it is much less costly to the organization to rehire an old employee than to hire a new one. Organization culture and support for use of work-life benefits should be analyzed in order to determine whether there are organization-specific factors that make it easier or harder for employees to return to work. In addition, managers should be evaluated as they likely shape employees’ beliefs about the organizations’ support for their balancing of identities outside of work. Future research should examine what makes engineering a particularly challenging field to return to and assess how organizations can facilitate the re-entry process.

Finally, future research should place more emphasis on understanding the experiences of men working in industry as this population has been largely ignored. Although women have appeared to be the engineering population most in need of examination due to their high dropout rates and low numbers, in order to meet the sizeable demands the US is projecting for these types of workers within the next decade, efforts targeted at the majority are likely to be most efficient and effective. If retention can be improved in men, who comprise nearly 90% of the engineers in America (NSF, 2013), the impact of even a 1% increase in retention would result in a much more dramatic rise in numbers than the same growth in women. This is not to say efforts to improve retention in women should not be continued or that they are not important, only that if numbers are the primary concern, research money and efforts would likely be utilized more effectively if focused on improving retention in the majority. Furthermore, men should also be more widely studied as the current research focus on women leads to the assumption that retention challenges in

engineering are a women's issue, although in this investigation men and women appear to share many similarities. Considering that men and women stayed in engineering for the same top two reasons, their enjoyment of engineering work and money, and both genders left or considered leaving due to work-life balance issues, an industry focus on improving these aspects should improve retention for both men and women. Targeting the factors both genders have in common has the potential to significantly improve numbers in engineering overall.

### **Conclusion**

The purpose of this investigation was to evaluate the role of professional identity in the field of engineering and the factors that influence male and female engineers' decisions to persist or leave the field. The results of this study indicate men and women in engineering may not be as different as thought as a great deal of overlap was found between genders in both the quantitative and qualitative aspects of the study. No gender difference was found in professional identity survey scores, meaning men and women reported similar levels of identification with engineering. Table 7 illustrates the qualitative themes found in both men's and women's interviews, highlighting the similarity between these groups. Few gender differences were found in the factors participants said influenced their decisions to persist in engineering as men and women cited the same main two factors. Enjoyment of engineering work was the primary reason both male and female persisters said they stayed in engineering, which was tied with money for men, and money was the second most commonly listed factor for women. Similarity was also found in the factors that encouraged men and women to leave engineering as work-life balance was found to be a critical factor related to decisions to leave engineering in all four of the groups, closely followed by competing interests, which pulled many away from the field. Mismatched values also influenced retention in both men and women, although to a lesser extent.

Table 7

*Qualitative Themes Found in Both Male and Female Participants*

Themes		
Identity	Reasons to Stay	Reasons to Leave
Identify as an engineer	Enjoyment of engineering work	Work-life balance/Children
Identity through relationships	Money	Competing interests
Does not identify		Mismatch in values

In this investigation, both persisters and non-persisters of each gender were found to identify strongly as engineers, which would not be expected if only those who identified persisted in the field. Persisters scored higher on professional identity than non-persisters in both genders, and there was a statistically significant, although small, correlation found between professional identity and persistence. Although this investigation cannot determine causality, these findings indicate there is a relationship between professional identity and persistence for both men and women. Identity alone does not appear to offer a sufficient explanation for turnover or retention in engineering. However, the qualitative findings highlight the personal importance and meaning individuals feel with regards to their engineering identities, which may explain why people continue to identify as engineers after leaving the field. Engineering identity seems to be important in the way people think about themselves, the work they do, the skills they possess, and the way they live their lives. It was evident in many of the interviews that individuals possessed an emotional attachment to their identity as an engineer, which fit with the social identity approach that was applied to the findings. Some demonstrated the meaning of this identity through discussions of the pride they felt for having earned an engineering degree, while for others, this was seen in the evident attachment they still felt to engineering, years after leaving. For many of the participants, engineering was a way of life and a



natural part of them that was central to who they were. In individuals like this, it did not seem to matter whether they were working as an engineer or not, they still saw themselves as engineers and found ways to apply engineering in their lives.

Identification with engineering appeared to be beneficial as it seemed to be connected with engagement in one's work and made many feel they did not want to leave the field. For others, identification encouraged them to make adaptations which enabled them to persist despite the presence of outside challenges or barriers. Conversely, a lack of identification with engineering, or doubts about one's group membership, created issues for some. This was often related to the limited prototype of an engineer, which caused some to identify only partially or not see themselves as true engineers due to perceptions of what constitutes engineering work. Several individuals who worked in non-traditional or managerial roles seemed to feel they were not true engineers because of the positions they held, and seemed unsure of their fit within engineering. This was also demonstrated by the women who left due to competing interests, as they felt their possession of outside interests meant they were not real engineers. Individuals like these seemed to value their engineering identity but hold this identity somewhat privately as they felt they were different, and thus could not fully be part of the group.

This investigation is valuable for several reasons. First, it offers one of the largest examinations to date on professional identity in male engineers, as well as the factors that influence retention in this population. In addition, men were included as a main comparison group, rather than only briefly touching upon their findings, as is common in research in this area that includes a male sample. The comparison of men and women in this investigation is of value because men and women in engineering tend to be positioned as highly distinct populations, yet there is little evidence which supports this claim as the experiences of men have largely been overlooked. While research has focused on women with the intention of improving their retention and reducing their minority

status, the continual comparison of women in opposition to men and the male culture of engineering has made their retention in the field a women's issue, not an issue that needs to be addressed at the level of the field.

In this investigation, a great deal of overlap was found between the factors that influence retention and turnover in the field for both men and women. This finding provides evidence that the message should be modified from saying changes should be made to improve women's retention in the field, to instead placing emphasis on making changes to improve retention in the field of engineering overall. Since the factors that retain women appear to be the same factors that retain men, research recommendations and interventions targeted on improving these factors in the field may have a greater impact and influence on the culture, making it a more engaging and comfortable place for all engineers to work. This may also bolster the numbers of engineers in the field, closing the gap between the number of STEM workers available in the US, and the number needed in order for us to maintain our competitive edge.

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**Appendix A: Professional Identity Measure**



### **Appendix A: Professional Identity Measure**

(Plett et al., 2011)

Indicate the degree to which the following statements are true for you on a scale from 1 (*not at all*) to 5 (*very true*).

1. Being an engineer is an important reflection of who I am.
2. I feel strong ties to engineers.
3. I am proud to be an engineer.
4. Society views engineers as an asset.