RESEARCH ARTICLE

Navigating a Career in Academia: Insights from Emeriti Engineering Faculty

Sylvia L. Mendez[1] · Jennifer A. Tygret[1] · Katie Johanson[1] ·
Valerie Martin Conley[1] · Comas Haynes[2] · Rosario Gerhardt[2] · Kinnis Gosha[3]

Abstract

This holistic single-case study design grounded by Sternberg's Triarchic Theory of Intelligence explores the perspectives of renowned emeriti engineering faculty on the future of the engineering professoriate and the factors that can lead to a successful professional trajectory for early-career, tenure-track engineering faculty. The emeriti faculty also share how they observed the ways in which race/ethnicity and gender, and the intersection of the two, influence the professional paths of early-career engineering faculty. Findings indicate the emeriti faculty believe the future of the engineering professoriate will be based on faculty continuing to develop useable technology that improves the human condition. Emeriti faculty note the appropriate balance of teaching, research, and service is dependent upon one's individual circumstances and one's creative, analytical, and practical abilities. They also share the balance can be complicated for underrepresented minority (URM) and female faculty. A thorough understanding of the factors emeriti faculty believe are critical for achieving promotion and tenure in the engineering professoriate may have the potential to positively impact the professional trajectories of early-career faculty.

Keywords Mentoring · Emeriti engineering faculty · Early-career engineering faculty · URM faculty · Case study

✉ Jennifer A. Tygret
jtygret@uccs.edu

1 University of Colorado Colorado Springs, 1420 Austin Bluffs Parkway, Colorado Springs, CO 80918, USA

2 Georgia Institute of Technology, North Ave NW, Atlanta, GA 30332, USA

3 Morehouse College, 830 Westview Dr SW, Atlanta, GA 30314, USA

🖄 Springer

Introduction

Learning the ways in which to navigate a career in academia and to balance the demands associated with the profession is a complex and complicated process for early-career faculty, specifically faculty members who are working to achieve tenure. While many avenues are available to seek advice on success in the world of promotion and tenure, little scholarly work has been devoted to this topic in the engineering field. A thorough understanding of factors for success in engineering may provide needed guidance in navigating tenure and positively impact the professional trajectories of early-career, tenure-track faculty. Therefore, the purpose of this holistic, single-case study (Yin 2018) grounded by Sternberg's Triarchic Theory of Intelligence (1985, 1988) is to share the collective wisdom of renowned emeriti engineering faculty who provided insights on the future of the engineering professoriate and the factors they view as critical to success in achieving promotion and tenure. As these professional practices and qualities vary substantially by discipline, emeriti faculty in the same field are in a position to illuminate these valuable characteristics to their early-career counterparts.

While the emeriti faculty perspectives on the professional practices and qualities needed to advance in academia pertains to all engineering faculty seeking tenure, the emeriti faculty also shared the ways in which they have observed how race/ethnicity and gender, and the intersection of the two, influenced the professional paths of early-career engineering faculty. Thus, this research provides specific consideration for female and URM early-career faculty as well. The research questions for this study are:

1. What is the future of the engineering professoriate?
2. What factors can lead to a successful professional trajectory for early-career engineering faculty?
3. What are the ways in which race/ethnicity and gender, and their intersection, influence the career success of early-career engineering faculty members?

Literature Review

A majority of faculty cite a passion for the discipline as the primary reason for pursuing a career in academia (Bosanquet et al. 2017). Yet, passion alone will not equate to promotion and tenure if early-career, tenure-track faculty do not demonstrate excellence in teaching, research, and service. In teaching, it is essential faculty deliver course content in an inclusive, accessible format coupled with high and realistic expectations for student learning and achievement (Austin and McDaniels 2006). Research contributions, by way of publications, presentations, and sponsored program activity, typically hold the most weight in promotion decisions—particularly for those who must secure grants (Anderson et al. 2007; Austin and McDaniels 2006; Fairweather 1993; Green 2008; Luchs et al. 2012; Soto 2014). In order to efficiently fulfill service expectations, early-career faculty need to align activities with promotion and career goals, such as university committee work and mentoring students (Austin and McDaniels 2006; Sorcinelli 2011). However, service may be complicated for URM

and female faculty, as often they receive and accept more service requests than others, due to their underrepresentation (Baez 1999; Dancy and Gaetane 2014; Hurtado and Figueroa 2013; Rockquemore and Laszloffy 2008).

Forging relationships are one way for early-career faculty to advance professionally and build a reputation in the field. Frequently this occurs through mentorship from senior faculty who can orientate new faculty in department expectations and tenure processes, as well as aid them in developing a network of colleagues who will support them through promotion, tenure, and beyond (Cawyer et al. 2002; Hyers et al. 2012; Yun et al. 2016). This is particularly important for early-career faculty who must learn the values, ethos, and philosophy of their institution to guide their efforts and to improve the possibility of positive tenure evaluations (Austin and McDaniels 2006; Fairweather 2002). In particular, URM and female faculty benefit from explicit guidance and mentorship, as often they do not receive informal career advice (Blood et al. 2012; Buzzannell et al. 2015; Hyers et al. 2012; Yun et al. 2016). This is especially concerning for URM and women because URM and female role models are scarce in science, technology, engineering, and mathematics (STEM) fields (Bhatia and Amati 2010; Yoder 2018). Specific to engineering, 6.3% of all engineering faculty identify as URMs (African American, Latinx, and Native American; National Action Council for Minorities in Engineering 2014), and women account for 16.0% of all engineering faculty (Yoder 2018).

Managing the heavy workload and chronic stress related to the demands of the professoriate is the primary challenge often cited by early-career faculty (Rockquemore and Laszloffy 2008; Sorcinelli 2011; Soto 2014). Time management techniques, such as setting priorities and avoiding multitasking, is an important skillset in academia due to the myriad of projects to complete simultaneously (Sorcinelli 2011). Additionally, new faculty often struggle with balancing work responsibilities with their personal and family life. Respondents to a survey by Bosanquet et al. (2017) reported feeling forced to sacrifice personal life goals, such as starting a family, in order to manage their heavy workloads. This finding was particularly salient among female faculty, who tend to serve as primary caregivers (Barrett and Barrett 2011; Bosanquet et al. 2017; Nelson-Gray 2012; Schiebinger and Gilmartin 2010); they often report feelings of guilt and selfishness when they spend time away from their families (Soto 2014). In reality, it can negatively affect the possibility of promotion and tenure, as men are nearly 40% more likely to earn tenure than women after having children (Ceci and Williams 2007; Handelsman et al. 2005; Rosser 2004).

Managing the goal of promotion and tenure while navigating entry into academia can be challenging and may lead to feelings of isolation and extreme worry about achieving tenure (Gappa et al. 2007). Thus, specific personality traits can increase the success of early-career faculty in academia. For example, collegiality and serving as a team player are important ways to establish oneself and to build a positive reputation in the field, as well as to engage in a community of scholars (Bronstein and Ramaley 2002). Pritchard (2015) also described the concept of "mental toughness" (p. 98) as a useful tool for working toward personal and professional goals, which involves approaching work mindfully, adopting an objective lens to deal with difficult situations, and using emotions to feel empowered.

Theoretical Framework

To guide this study, Sternberg's (1985, 1988) Triarchic Theory of Intelligence was selected as the theoretical framework. Theoretical frameworks build on a foundation of established knowledge, offer logical explanations for the relationships observed, and reveal new understandings about a phenomenon (Anfara and Mertz 2014; Babbie 2015). The theory provides a structure for contemplating the ways in which the emeriti faculty conceptualize the three components of intelligence articulated by Sternberg:

1. Creative abilities: an individual's capacity to generate new ideas;
2. Analytical abilities: the ability to decide which ideas to pursue; and.
3. Practical abilities: the process of putting ideas into practice and persuading others of their value.

The role of intelligence byway of creative, analytical, and practical abilities offers a framework for organizing and communicating the factors that can lead to a successful professional trajectory for early-career engineering faculty. Understanding the factors perceived to be most desirable and keys to success in the engineering professoriate, as well as the ways in which race/ethnicity and gender can influence the career success of early-career engineering faculty, will be shared through the theoretical framework.

Methodology

Research Design

A holistic, single-case study design (Yin 2018) grounded by Sternberg's Triarchic Theory of Intelligence (1985, 1988) was utilized to explore the future of the engineering professoriate and the factors that can lead to a successful professional trajectory for early-career engineering faculty. The theoretical propositions that intelligence is actualized in three components (creative, analytical, and practical) underpinned the critical case approach of the study. As noted by Yin (2018), theoretical propositions are important in placing the circumstances in which a phenomenon is to occur—in this case, the ways in which intelligence translates to a successful academic career in engineering. Inquiries also were conducted to understand whether race/ethnicity and gender, and their intersection, influence the professional trajectory of early-career female and URM engineering faculty from the viewpoint of emeriti faculty. Multiple one-on-one interviews with the emeriti faculty allowed for their rich perspectives and experiences to be explored over time (Stake 1995; Yin 2018). The research questions of this study were:

1. What is the future of the engineering professoriate?
2. What factors can lead to a successful professional trajectory for early-career engineering faculty?
3. What are the ways in which race/ethnicity and gender, and their intersection, influence the career success of early-career engineering faculty members?

Participants

Seven emeriti engineering faculty were selected to participate in this study because of their renowned stature in the field, collective expertise, and continued engagement in academia during retirement. Their perspectives are based on their years of experience in the engineering field, and particularly their continued role as leaders in their discipline. Most maintained federal grants and contracts and research labs, some taught undergraduate and graduate engineering courses, and one held an administrative assignment in his Provost's Office. All participants were White, male, and retired from the same doctoral-granting university with very high research activity, representing various engineering disciplines such as aerospace, biomedical, chemical, industrial systems, and mechanical.

Data Collection

This study is part of a larger project that focuses on the Increasing Minority Presence within Academia through Continuous Training (IMPACT) mentoring program that pairs emeriti and URM (male and female) early- and mid-career engineering faculty for career mentorship. The IMPACT program and this research were sponsored by a National Science Foundation Office for Broadening Participation in Engineering award (15–42,728 and 15–42,524) and an INCLUDES (Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science) Design and Developments Launch Pilot award (17–44,500). Over the course of two years of the IMPACT program, emeriti faculty were invited to participate in four rounds of interviews; four individuals took part in all rounds, two in three rounds, and one in two rounds, resulting in 24 completed interviews.

Per Institutional Review Board approval, all individuals were provided with consent forms detailing the purpose of the study and the interview procedures. The interviews averaged 45 min in length, were digitally recorded, and were conducted through a one-on-one process with one interviewer to ensure the data were gathered in a systematic manner (Patton 2015). Four semi-structured interview protocols were developed to allow questions to be carefully worded and asked in a specific order; probing questions were embedded to provide opportunities to seek clarification (Patton 2015).

Data Analysis

The interview data were analyzed using both inductive and deductive techniques. Silverman's (1993) inductive approach of finding themes and patterns occurred by coding in cycles and embedding opportunities for frequent reflection. Using this method, data were coded in a comprehensive manner to identify cross-references between the data and the evolving themes while memoing. During the first cycle, descriptive codes were created that summarized the basic topics of the data, as well as evaluative codes to categorize specific career insights from emeriti faculty (Miles et al. 2019). During the second cycle, data were again reviewed, and emerging themes and patterns were identified. During the third cycle of coding, Stake's (1995) four-step deductive process was followed to report the themes, which included direct interpretation, categorical aggregation, pattern recognition, and naturalistic generalizations

using Sternberg's Triarchic Theory of Intelligence (1985, 1988). The emerging themes and patterns from the inductive analysis were compared with the theoretical framework to further define and finalize the themes (Patton 2015). After additional memoing and review of the data, four final themes were identified.

Trustworthiness

Multiple verification strategies ensured the findings were trustworthy (Lincoln and Guba 1985). In order to address credibility, cross-case synthesis was utilized throughout the analysis of each interview to examine whether the themes were cases of similar or different perspectives of the emeriti faculty (Hayes 1997). Miles et al. (2019) highlighted the flexibility of this approach when data collection occurs in a phased design. To ensure transferability, thick, rich descriptions were utilized, and data saturation occurred prior to the completion of all 24 interviews (Patton 2015). Dependability was addressed by evaluating the manner in which the themes represented the whole of the text (Silverman 1993; Stake 1995). Confirmability was ensured by validating themes in the early and late stages of the data analysis process (Miles et al. 2019). Dependability and confirmability were accomplished by involving multiple researchers in evaluating and providing feedback on the identified themes, which enabled the comparison of several feedback loops. Application of these verification methods mediated the limitation of including only emeriti faculty who participated in the IMPACT program, self-selected to be interviewed, and self-reported their views and experiences (Lincoln and Guba 1985; Miles et al. 2019).

Findings

Following data analysis, four themes emerged. The emeriti faculty shared their viewpoints on the future of the engineering professoriate; defined factors for success for all early-career engineering faculty seeking tenure and promotion; and provided insights into the influence of race/ethnicity and gender, and their intersection, on the career success of engineering faculty.

The Future of the Engineering Professoriate: Improving Humanity and Bifurcation

All emeriti faculty identified "improving humanity" as an important component to the future of the engineering professoriate. One noted, "[In engineering] we make things better for humanity. We're the makers. We're not the discoverers of knowledge. Those are the scientists. We're the people who make things with scientific principles." As each noted, engineers develop new technologies that are translated into useful, real-world activities to better the human condition; they believe the engineering professoriate will continue to reward faculty who are efficacious in that endeavor. One participant commented successful engineering professors of the future will "graduate people who have a commitment to making life better, which could mean safer airplanes and better bridges and healthcare delivery systems that are technologically sound." They spoke as one in describing the importance of investing in the future of the engineering professoriate, as they view it as a central investment in the future of humanity and society. Therefore, in order to be successful in engineering academia, all three abilities

of Sternberg's Triarchic Theory of Intelligence (1985, 1988) are required: creative abilities for developing technologies to improve humanity, analytical abilities to decipher that which is needed for "making life better," and practical abilities for turning ideas into reality.

When looking toward the future, the emeriti faculty articulated a need for new ways to restructure engineering academia to ensure its survival in an era of scarce resources and intensifying demands on faculty. A few indicated a need to "bifurcate" the pathway to tenure by rewarding what they described as the "classic professor" who engages in teaching, research, and service, as well as the professor who focuses exclusively on the teaching realm. One participant stated, "We're going to hire a lot more instructors and we are going to need to honor those instructors with giving them more teaching professorships with no research role." Another asserted, "There are too many universities where people are forced to pretend to do research and that is going to have to end because there's not enough funding to go around." These types of structural changes were seen as necessary to ensure engineers in academia are rewarded for their contributions and recognized for their varied talents, rather than expecting all early-career faculty to perform along the same traditional lines of teaching, research, and service. Another emeriti faculty member emphasized tenure decisions should be based on a professor's strengths and the ways in which he or she best contributes to the university and the engineering profession, rather than narrowly through the guise of teaching, research, and service. He believes the "classic professor" expectation is outdated and inhibits academia from being responsive to the needs of institutions, students, and the greater society.

Professional Practices for Success: Seeking Balance and Mentorship

The emeriti faculty identified professional practices needed of all early-career faculty members in order to be successful in earning promotion and tenure in the engineering field. As one participant described, "Academia is a real rat race"; success in teaching, research, and service is necessary for tenure and promotion. Early-career faculty must focus on each area; however, as one emeriti faculty member articulated, it is a "daunting challenge" for new professors to find the right balance. As all institutions are different, participants emphasized the importance of tenure-track faculty knowing and satisfying the expected balance for their specific institution.

Research and publications in engineering tend to carry the most weight, even outside the top-tier research universities. In order to advance professionally, the emeriti faculty stressed that early-career faculty must conduct original and innovative research that "results in good work for humanity." In addition, they should produce high-quality publications, rather than focus solely on the number of publications. In the words of one emeriti faculty participant, "The issue is not just having a bunch of publications, but having publications that are meaningful, and of an intellectual depth that they lead to new ideas, new technologies." However, most participants acknowledged numbers are still important. As one described, universities are "numbers driven," and the "number of publications, number of dollars brought in" impact an early-career faculty's career trajectory. "Number of dollars" relates directly to securing grants and funding, which also was identified as necessary for success. While securing external funding alone does not equal success in the eyes of the emeriti faculty, it provides opportunities

to create a more "active research lab," which ultimately results in additional funding and publications. While the emeriti faculty support a balance between teaching, research, and service, they warned against overemphasizing teaching because it may hinder competitiveness if a professor desires to leave their institution. In addition, teaching is held to a different standard than research. One participant described a common belief in the STEM fields that "teaching is punishment for not producing enough research." It is important to note not all agreed with this sentiment; however, it was acknowledged as a reality at some universities.

In order to understand the expectations for new faculty and to grow in the profession, emeriti faculty emphasized the importance of early-career faculty engaging in mentorship opportunities. While new faculty may have been success-ful as graduate students, upon becoming professors they are "basically starting over," as one participant articulated. Connecting with a mentor helps in navigating academia, as well as having the opportunity to advance knowledge in the engi-neering field, to hone one's teaching skills, and to provide service in one's areas of expertise. Some institutions offer mentoring programs for tenure-track faculty, but nearly all of the participants noted that, in the engineering field, some new faculty feel they should be able to "stand on their own" and do not take advantage of mentoring opportunities. However, they believe it is vital for early-career faculty to commit to mentoring not only to understand the demands of academia, but also to get involved in conferences and research teams to grow their professional networks. As one emeriti faculty member emphasized, "Survival [in academia] is very much influenced by the steps you take early on. .. [new faculty] are going to need help. They're going to need guidance." Mentors can provide the needed counsel and support for faculty to not only survive, but also to thrive.

The professional practices described by the emeriti faculty directly relate to Sternberg's (1985, 1988) three components of intelligence. Each emphasizes success in teaching, research, and service; finding the right balance among the three requires the creative, analytical, and practical abilities of the Triarchic Theory of Intelligence. Consequently, early-career engineering faculty must possess the creative abilities of innovation and originality; demonstrate the analytical abilities of discerning areas of synergy to pursue; and, finally, the practical abilities to ensure they are meeting the appropriate balance of teaching, research, and service for their individual institutions. In addition, pursuing mentoring relationships can assist early-career faculty in the devel-opment of their creative, analytical, and practical abilities, as well as enhance their likelihood for success in the engineering professoriate.

Personal Qualities for Success: Concentration, Collaboration, and Creativity

The emeriti faculty acknowledged the "pressure is intense" in academia; therefore, "deep concentration" by way of "grit, persistence, and the ability to overcome chal-lenges" is essential to success in the engineering field. Additionally, respect, dedication, hard work, and organization were qualities identified as important for success. They believe innate talent in the field is imperative, but in the words of one participant, "talent can only get someone so far." The emeriti faculty stressed talent is to be nurtured and channeled so early-career faculty know in what direction to focus their career; nurturing talent was seen as one of their roles as senior faculty in the field. One

participant added being a professor in engineering is "the best job in the world, but you have to love it, because you can't do it if you don't love it."

In addition to concentration, the ability to collaborate and get along with others is a personal quality essential for professional advancement. The emeriti faculty stressed the importance of early-career faculty participation in team activities. As one participant pointed out, "[engineering] is not a single artist in a studio, it's a team of people"; therefore, collaboration is key. Similarly, another described research as "a people business"; faculty must possess the "social skills to interact with and benefit from other people." One participant articulated, "You're not going to last if you cannot get along [with others]." Engineering faculty not only need the social skills to collaborate with their colleagues, but they also must work well with students when conducting research and in teaching. One emeriti faculty member believes charisma is important "to attract graduate students" to faculty research projects. Likewise, professors should possess the personality "to convince somebody to support research that you think needs to be done to improve something."

The emeriti faculty also emphasized the need for creativity in ensuring not only one's success in the engineering professoriate, but also their legacy as a leader in the field. While they stressed the importance of possessing the technical skill and analytical ability needed for engineering, they also believe these traits alone will not help early-career faculty to advance. They must have vision "to see things a little differently than people or find a niche that other people haven't found." The participants described the ability to view a problem through a creative lens and find different solutions and connections, which they identified as essential to becoming a leader in engineering. In the words of one emeriti faculty, "Non-creative people, they can go into engineering, because of their analytical ability, but they can't really become a leader. People who are leading the engineering fields are people who are extremely creative." In unison, they agreed on the importance of the next generation of engineering professors having fresh and unique ideas. The emeriti faculty believed one of their roles is to promote and foster this creativity.

Each of the personal qualities identified by the emeriti faculty as necessary for success connect to Sternberg's (1985, 1988) Triarchic Theory of Intelligence. Concentration requires the alignment of all three components of intelligence: creativity to find solutions, analytical ability to understand the ideas to pursue, and practical ability to persist in the face of challenges. As described by the participants, the people skills of collaboration and getting along with others are captured in the practical ability component. Professors must possess the practical ability to relate with peers and students, to put their ideas into practice, and to persuade others to join them. In addition, professors must combine the analytical and practical abilities to know which colleagues and students will be assets to their research and projects. Finally, the way in which the emeriti faculty discussed the importance of creativity, which is the ability to generate new ideas and unique solutions, mirrors Sternberg's description of creativity.

The emeriti faculty also believe certain personal qualities are detrimental to an early-career faculty member's professional trajectory, such as arrogance or vanity. Being overly controversial or disregarding precedent and tradition can hinder success. One participant noted early-career professors will not be taken seriously if they are not "credible" or have no evidence to demonstrate their ideas have worked. He warned against being "all talk" and having no experience, which may lead to one's "value

being diminished" in the field. These personal qualities relate to Sternberg's (1985, 1988) analytical and practical components of intelligence—if faculty lack the ability to anticipate and avoid these potential attitudinal and dispositional pitfalls, they will struggle in academia.

Unique Challenges Faced by Female and URM Faculty: Service and Underrepresentation

Most of the emeriti faculty participants believe race/ethnicity and gender, and their intersection, can impact an early-career faculty member's professional trajectory. Nearly all acknowledged the challenge URM and women faculty face in achieving a balance between teaching, research, and service, as often they are expected to perform more service duties than their counterparts in order to demonstrate an institution's commitment to diversity. One participant remarked, "The good news is universities realize they have to have diversity on their committees; the bad news is there's not that many [diverse] faculty and so the same faculty are called on." Thus, service responsibilities can be quite complicated for female and URM faculty; they may be "caught in the trap" of focusing their time on service rather than on their research agenda and on refining their teaching abilities.

One emeriti faculty member added that "cultural kinds of gaps" exist between URM and women faculty and their colleagues relative to service; often female and URM faculty consider service "a responsibility," while their counterparts consider it "a distraction." Nearly all participants noted this gap often is raised in promotion and tenure decisions. Therefore, they encourage URM and women faculty to identify a mentor or constellation of mentors to answer questions about the "right service to engage in" and to connect them with other colleagues who can mediate potential and actual challenges as they navigate the expectations of academia. This is another example of the ways in which Sternberg's (1985, 1988) analytical and practical abilities are necessary for early career faculty; they must apply those abilities in connecting with mentors and colleagues in order to find an appropriate balance and path in the service they perform.

All emeriti faculty described the underrepresentation of female and URM faculty as a challenge to the engineering field, as one stated, "there aren't enough of them [female and minority professors] in the pipeline." Each stressed the importance of actively promoting academic career pathways with women and URM students. Some noted this could best be achieved by focusing on the ways in which "engineering thinking" can improve various environmental and medical conditions too often experienced by minority communities, such as water contamination, air pollution, hypertension, and cardiovascular disease. All agreed the pathway to the professoriate must be disrupted to ensure the next generation of engineering faculty reflect American society to a greater degree. In addition, the future of engineering should focus on and meet the engineering needs of minority communities.

One emeriti faculty noted increasing the number of female and minority professors in the engineering field is difficult due to historic barriers that have excluded their participation. He noted inadequate pre-college educational experiences, as well as racism and sexism in the academy, have limited their entrance and success. While he believes those obstacles are "in the past" and "those barriers are being dismantled," he

emphasized the importance of making a conscious effort to increase the diversity of the professoriate: "If we are to have the engineering workforce we need for the 21st century, we have to bring in these underrepresented populations.. . it is the necessary thing to do." Other emeriti faculty indicated these barriers continue to exert an influence to some degree today, implying race/ethnicity and gender impact an individual's opportunity to secure a position in academia and to progress in the profession. This also indicates that even if female and URM faculty possess the creative, analytical, and practical abilities outlined by Sternberg (1985, 1988) and described by the emeriti faculty, there are other barriers of influence that impact career trajectories.

In contrast to a majority of the emeriti faculty comments on the significance of race/ethnicity and gender in the engineering field, it is important to note one participant was unsure of the difficulties URM and women faculty may currently face: "I'm sure in the past [race/ethnicity and gender] has played a significant role [in promotion and tenure decisions]. These days, I don't have a good perspective to say something real knowledgeable." While these comments were limited to one individual's experience, they suggest race/ethnicity and gender, and their intersection, may not be noticed or perceived as relevant by some emeriti faculty. This insufficient awareness could indicate a lack of cultural competence and knowledge on the experiences of female and URM faculty in engineering academia.

Discussion

One of the major challenges faced by early-career, tenure-track professors is in navigating the mounting demands and expectations of academia. The perspectives and insight of those who have walked before them provide new faculty with tangible tools for charting the course of their academic careers and for considering the future of the engineering professoriate. This study adds to the literature by providing insight into the professional practices and personal qualities identified by emeriti faculty as critical for a successful career in academia. In addition, it illuminates the abilities early-career faculty may need to develop and possess in order to earn tenure and to advance in the field. It is worth reiterating the experiences and perspectives were shared by renowned, emeriti faculty who are White males. While we are not attempting to privilege their voices, the reality is these individuals possess a wealth of experience and have long served as leaders in the engineering professoriate. Thus, their viewpoints on factors for success could be critical information that is beneficial to early-career faculty who may not possess the mentorship or networks to readily access the perspectives of emeriti faculty who are predominately White males. It is also important to note that the inclusion of all White males is a result of historic barriers described by the emeriti faculty themselves. As they noted, historically the numbers of URM and women engineering faculty are small, thus, there are relatively few URM and women emeriti faculty compared to White male emeriti faculty. This is another reason why diversifying the engineering professoriate is imperative.

This study provides unique viewpoints of emeriti faculty on the future of engineering academia, which also are important for early-career faculty to consider as they begin their careers. According to the participants, the future of the field of engineering is grounded in the continued development of practical technologies that improve the

human condition. Each emeriti faculty member stressed professors who inspire others to think along those lines will continue to be instrumental in academia, as more individuals are needed in the field, particularly women and those from URM communities. They also articulated the necessity to reconsider the role of the tenured faculty member. They agreed the "reward of tenure" should not be for only those who are successful in teaching, research, and service; the role of the instructor who does not have research responsibilities must be elevated to also allow for tenure eligibility.

By sharing perspectives and experiences from their days in academia, the emeriti faculty defined the necessary attributes for success. In addition to professional steps to pursue, that include discovering the appropriate balance between teaching, research, and service, personal qualities and attitudes such as concentration, collaboration, and creativity are important when seeking promotion and tenure. Past scholars also have identified these traits as necessary for success (Bronstein and Ramaley 2002). Moreover, the valued personal qualities described by the participants align with Pritchard's (2015) description of mental toughness, which is an increasingly important attribute as academia becomes more demanding and requires faculty to employ mindfulness skills in order to thrive.

It is important to highlight the impact of race/ethnicity and gender on early-career faculty. From the perspectives of the emeriti faculty participants, female and URM faculty may experience additional challenges, as the intersection of their identities results in being called upon more frequently for service-related activities such as mentoring students of color and serving on diversity-related university committees. The perspectives of the emeriti faculty are based on their years of experience in the engineering field, as well as their observations and connections with early- and mid-career faculty, including the URM (male and female) faculty within the IMPACT mentoring program with whom they were paired for career-focused mentorship. Concerns voiced by the participants relative to the service load URM faculty often are called upon to assume are consistent with the literature stating these individuals are expected to be more involved in service activities than non-URM faculty (Baez 1999; Rockquemore and Laszloffy 2008; Soto 2014).

Each of the emeriti faculty also described the existence of historical barriers that have prevented underrepresented populations from entering the field of engineering. While those obstacles may not be as prevalent today, their existence has made a lasting impact on the profession; presently about 6% of engineering professors identify as URM (National Action Council for Minorities in Engineering 2014) and only 16% are women (Yoder 2018). All emeriti faculty noted the lack of a critical mass of female and URM engineering faculty hampers the ability of undergraduate and graduate students having role models in their discipline. Bhatia and Amati (2010) found the presence of females in engineering empowers the younger generation to persist in the field; their absence negatively affects the attraction to the profession. According to the emeriti faculty participants, senior faculty as well as incoming faculty must work collectively to break down barriers and explore new ways to attract and retain women and URM faculty. However, in order to increase their numbers, a need exists for more women and URM students majoring in engineering and pursuing a career in academia. Faculty must possess the charisma and ability to work well with others, as described by the emeriti faculty, in order to attract new students into the field and to dismantle existing barriers. This is an area for further research and exploration.

Sternberg's (1985, 1988) components within the Triarchic Theory of Intelligence align with the career insights delineated by emeriti faculty as necessary for success. Knowledge of these practices and qualities can provide a "roadmap" for early-career faculty as they begin their pursuit of tenure; however, the importance of securing a mentor also was emphasized. As all institutions are different, receiving specific feedback and support from senior faculty at the same or a similar university further benefits new faculty and their career trajectory. Further, mentorship proffers the advantage of learning about a particular department's values and principles—an essential means of increasing the likelihood of success in the professoriate (Austin and McDaniels 2006; Fairweather 2002).

However, as the field of engineering becomes more diversified, it is important to revisit the components of Sternberg's (1985, 1988) Triarchic Theory of Intelligence to identify whether the three components continue to align with the factors for success in achieving tenure and promotion, specifically for female and URM faculty. As noted by the emeriti faculty, there may be additional barriers for URM and women faculty; therefore, possessing the Triarchic components alone may not be sufficient for female and URM faculty in achieving tenure and promotion. While the creative, analytical, and practical skills are necessary to navigate the demands of academia and overcome historical barriers, further research is needed to identify additional abilities that URM and women faculty themselves note as necessary for success. However, this relies on the diversification of the field, as there are so few female and URM senior and emeriti faculty to provide insight at this time. As noted above, there were no URM (male or female) emeriti faculty to serve as mentors for the IMPACT project. Thus, the lack of URM and female voices further supports the critical need for diversity in this field.

Conclusion

Few studies have investigated the professional and personal qualities necessary for success in the engineering professoriate; therefore, this holistic, single-case study fills the gap through targeted interviews with emeriti faculty. This research provides insights from the experiences and perspectives of renowned, emeriti engineering faculty on the future of the profession and ways to effectively navigate a career in academia. It also calls attention to how race/ethnicity and gender, and their intersection, influence the success of early-career faculty. Defining the professional practices and personal qualities early-career engineering faculty may need to exhibit in order to be successful provides an "insider" perspective with valuable guidance in developing one's professional trajectory within the field. However, the practices and qualities identified by emeriti faculty are not specific to engineering; thus, this research provides all new faculty with practical insights into success in academia.

necessarily reflect the views of the NSF. An earlier version of this paper was presented at the 2019 American Educational Research Association in Toronto, Canada. We are grateful for the comments and suggestions provided by the AERA and *Journal for STEM Education Research* reviewers.

References

Anderson, M. S., Ronning, E. A., De Vries, R., & Martinson, B. C. (2007). The perverse effects of competition on scientists' work and relationships. *Science and Engineering Ethics, 13*(4), 437–461. https://doi.org/10.1007/s11948-007-9042-5.

Anfara, V. A., & Mertz, N. T. (Eds.). (2014). *Theoretical frameworks in qualitative research* (2nd ed.). Thousand Oaks: Sage.

Austin, A. E., & McDaniels, M. (2006). Preparing the professoriate of the future: Graduate student socialization for faculty roles. In J. C. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. 21, pp. 397–456). Dordrecht: Springer. https://doi.org/10.1007/1-4020-4512-3_8.

Babbie, E. (2015). *The practice of social research* (14th ed.). Boston: Cenage.

Baez, B. (1999, Fall). Faculty of color and traditional notions of service. *Thought and Action, 12*, 131–138.

Barrett, L., & Barrett, P. (2011). Women and academic workloads: Career slow lane or cul-de-sac? *Higher Education, 61*(2), 141–155. https://doi.org/10.1007/s10734-010-9329-3.

Bhatia, S., & Amati, J. P. (2010). "If these women can do it, I can do it, too": Building women engineering leaders through graduate peer mentoring. *Leadership and Management in Engineering, 10*(4), 174–184. https://doi.org/10.1061/(ASCE)LM.1943-5630.0000081.

Blood, E. A., Ullrich, N. J., Hirshfeld-Becker, D. R., Seely, E. W., Connelly, M. T., Warfield, C. A., & Emans, S. J. (2012). Academic women faculty: Are they finding the mentoring they need? *Journal of Women's Health, 21*(11), 1201–1208. https://doi.org/10.1089/jwh.2012.3529.

Bosanquet, A., Mailey, A., Matthews, K. E., & Lodge, J. M. (2017). Redefining 'early career' in academia: A collective narrative approach. *Higher Education Research & Development, 36*(5), 890–902. https://doi.org/10.1080/07294360.2016.1263934.

Bronstein, P., & Ramaley, J. A. (2002). Making the persuasive tenure case: Pitfalls and possibilities. In J. E. Cooper & D. D. Stevens (Eds.), *Tenure in the sacred grove: Issues and strategies for women and minority faculty* (pp. 31–55). Albany: State University of New York Press.

Buzzannell, P. M., Long, Z., Anderson, L. B., Kokini, K., & Batra, J. C. (2015). Mentoring in academe: A feminist poststructural lens on stories of women engineering faculty of color. *Management Communications Quarterly, 29*(3), 440–457. https://doi.org/10.1177/0893318915574311.

Cawyer, C. S., Simonds, C., & Davis, S. (2002). Mentoring to facilitate socialization: The case of the new faculty member. *International Journal of Qualitative Studies in Education, 15*(2), 225–242. https://doi.org/10.1080/09518390110111938.

Ceci, S. J., & Williams, W. M. (2007). *Why aren't more women in science?: Top researchers debate the evidence*. Washington, DC: American Psychological Association.

Dancy, T. E., & Gaetane, J. M. (2014). Faculty of color in higher education: Exploring the intersections of identity, impostership, and internalized racism. *Mentoring and Tutoring: Partnership in Learning, 22*(4), 354–372.

Fairweather, J. S. (1993). Academic values and faculty rewards. *The Review of Higher Education, 17*(1), 43–68. https://doi.org/10.1353/rhe.1993.0002.

Fairweather, J. S. (2002). The ultimate faculty evaluation: Promotion and tenure decisions. *New Directions for Institutional Research, 114*, 97–108. https://doi.org/10.1002/ir.50.

Gappa, J. M., Austin, A. E., & Trice, A. G. (2007). *Rethinking faculty work: Higher education's strategic imperative*. San Francisco: Jossey-Bass.

Green, R. G. (2008). Tenure and promotion decisions: The relative importance of teaching, scholarship, and service. *Journal of Social Work Education, 44*(2), 117–127. https://doi.org/10.5175/JSWE.2008.200700003.

Handelsman, J., Cantor, N., Carnes, M., Denton, D., Fine, E., Grosz, B., & Sheridan, J. (2005). More women in science. *Science, 309*(5738), 1190–1191.

Hayes, N. (Ed.). (1997). *Doing qualitative analysis in psychology*. Hove: Psychology Press.

Hurtado, S., & Figueroa, T. (2013). *Women of color faculty in science technology engineering and mathematics (STEM): Experiences in academia.* Paper presented at the American Educational Research Association annual meeting, San Francisco.

Hyers, L. L., Syphan, J., Cochran, K., & Brown, T. (2012). Disparities in the professional development interactions of university faculty as a function of gender and ethnic underrepresentation. *Journal of Faculty Development, 26*(1), 18–28.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry.* Newbury Park: Sage.

Luchs, C., Seymoure, S., & Smith, W. (2012). How important is service in the promotion and tenure process? *Research in Higher Education Journal, 15*, 1–11.

Miles, M. B., Huberman, A. M., & Saldaña, J. (2019). *Qualitative data analysis: A methods sourcebook* (4th ed.). Thousand Oaks: Sage.

National Action Council for Minorities in Engineering. (2014). Trends in the U.S. population and engineering workforce. *Research & Policy, 3*(5). Retrieved from http://www.nacme.org/images/pdfs/research/Trends_US_Population_Engineering_Workforce.pdf.

Nelson-Gray, R. O. (2012). Comments by ABCT's first female president on overcoming the glass ceiling. *Behavior Therapy, 43*(4), 705–707. https://doi.org/10.1016/j.beth.2012.03.004.

Patton, M. Q. (2015). *Qualitative research and evaluation methods* (4th ed.). Thousand Oaks: Sage.

Pritchard, P. A. (2015). Mental toughness. In P. A. Pritchard & C. Grant (Eds.), *Success strategies from women in STEM: A portable mentor* (2nd ed., pp. 97–138). Amsterdam: Elsevier Academic Press.

Rockquemore, K. A., & Laszloffy, T. (2008). *The black academic's guide to winning tenure—Without losing your soul.* Boulder: Lynne Rienner Publishers.

Rosser, S. V. (2004). *The science glass ceiling: Academic women scientists and the struggle to succeed.* New York: Routledge.

Schiebinger, L., & Gilmartin, S. K. (2010). Housework is an academic issue. *Academe, 96*(1), 39–44.

Silverman, D. (1993). *Interpreting qualitative data: Methods for analysing talk, text, and interactions.* Thousand Oaks: Sage.

Sorcinelli, M. D. (2011). The top ten things new faculty would like to hear from colleagues. Retrieved from https://www.bu.edu/sph/files/2012/01/Sorcinelli_Top-Ten-Things-New-Fac-Would-Like-to-Hear.pdf

Soto, M. (2014). *Women of color faculty in STEM: Successfully navigating the promotion and tenure process* (doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (AAT 3631258).

Stake, R. E. (1995). *The art of case study research.* Thousand Oaks: Sage.

Sternberg, R. J. (1985). *Beyond IQ: A triarchic theory of human intelligence.* New York: Cambridge University Press.

Sternberg, R. J. (1988). *The triarchic mind: A new theory of human intelligence.* New York: Viking.

Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). Thousand Oaks: Sage.

Yoder, B. L. (2018). *Engineering by the numbers.* Retrieved from https://www.asee.org/documents/papers-and-publications/publications/college-profiles/2017-engineering-by-numbers-engineering-statistics.pdf.

Yun, J. H., Baldi, B., & Sorcinelli, M. D. (2016). Mutual mentoring for early-career and underrepresented faculty: Model, research, and practice. *Innovative Higher Education, 41*, 441–451.