



Towards the Development of a Research Engineer Identity Scale

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My research is focused on developing interdisciplinary theoretical frameworks and methodological designs capable of modeling the social and psychological drivers of behavior, decision-making, and information processing across multiple domains (e.g., education, food security, the environment).

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This paper reports on research that is part of a broader National Science Foundation (NSF)-funded, Innovations in Graduate Education (IGE) project. The project aims to enhance the research culture and broaden the participation in research of underrepresented groups within graduate engineering programs at a mid-sized historically black college or university. The project includes three initiatives that seek to assist in the development of a “research engineer identity” among the graduate students pursuing research-based degrees in the college. One of the three initiatives of the project, and focus of this paper, involves the development of a survey-based Research Engineer Identity Scale (REIS). A two stage sequential mixed-method research design is being used to develop the scale. This paper focuses on the first stage in the design which involved conducting focus groups with research engineers to gain insight into the content, character, and complications associated with internalizing a Research Engineer Identity (REI) in general and among people from underrepresented groups in particular. We report on four semi-structured focus groups that each lasted approximately 90 minutes in Fall 2019. Each focus group included about 6 to 9 faculty members, industry professionals, or graduate students who actively engaged in engineering research in the Southeastern United States. Focus group participants represented various academic disciplines within engineering as well as a range of demographic characteristics such as sex, race, ethnicity, and citizenship status. The focus group conversations were transcribed and transcriptions were entered into NVivo for coding and analysis. Inter-rater reliability procedures were used to ensure consistency of coding. This paper reports on the themes that emerged within the focus group discussions regarding what it means to “be a research engineer.” The findings describe similarities and differences across demographic characteristics in regard to the content, character, and complications associated with efforts to develop a Research Engineer Identity. The paper concludes by briefly describing the process that will be used to transform the emergent themes into pool of items to be included in a web-based questionnaire designed to measure Research Engineer Identity.

Introduction

This paper reports on National Science Foundation-funded research that is part of a broader project designed to create an infrastructure to provide an intentional and personalized focus on addressing the need for graduate students to develop a mature research stature and perspective as part of their research-based degrees. The project includes three initiatives that seek to assist in the development of a “research engineer identity” among the graduate students pursuing research-based degrees in the college. One initiative is to develop formal Small Research Groups that can provide a sustainable set of research units. Once established, these research units will be able to provide graduate students with research opportunities through which they can develop the knowledge, skills, and relationships needed to be a research engineer. Another initiative seeks to develop a Research Engineer Network (REN) of individuals that will impart skills and mentoring to graduate students, that may not available to them from their own major professor and her/his research group. The network will be composed of graduate students, select major professors, select faculty from R1 universities, and representatives from corporate research and federal research laboratories. The REN will have three tracks of activities: Research Progression Skills (REN-RPS), Research Networking Skills (REN-RNS), and Career Preview and Preparation (REN-CPP). Each track of activities will be offered in Fall and Spring. The REN will also have a one-on-one mentoring session with a focus on research engineer identity development.

The third initiative, and the subject of this paper, involves the development of a valid and reliable survey-based scale measure of Research Engineer Identity (REI). A two stage sequential mixed-method research design is being used to develop the scale. This paper focuses on the first stage in the design which involved conducting focus groups with research engineers to gain insight into the content, character, and complications associated with internalizing a REI in general and among people from underrepresented groups in particular.

Background Identity in STEM

The need to broaden participation within STEM fields to underrepresented groups has been recognized as vital for addressing complex global problems, generating economic growth, and promoting

social justice (Godwin et al., 2016; Subotnik, et al., 2010). Of specific importance to many is the need to broaden participation within engineering research and graduate programs (see Brown and Linden, 2008; Maton et al., 2015). However, recent research also points to a gap in our understanding of how identities among members of under-represented groups may impact their experiences and outcomes in STEM programs (Collins, 2018). Indeed, students from underrepresented groups face substantial barriers to success in both undergraduate and graduate STEM programs. Many of these barriers are unrelated to past academic achievement and ability, but are instead cultural, social, and psychological impediments that result from students' experiences within STEM programs and society at large (see Godwin et al., 2016 & Steenbergen-Hu et al., 2018). The construct of Identity has become one of the most useful tools for understanding and assessing the experiences of students from underrepresented groups within undergraduate and graduate STEM programs. Indeed, a strong STEM identity has been shown to be powerfully related to a students' interest in STEM fields, beliefs about their own capabilities within STEM (i.e., self-efficacy), and motivation to persist to graduation (Collins, 2018). However, research has also shown that incompatibility between gender and/or ethno-racial identity and the stereotype of engineering as a field appropriate for white males can impede the development of STEM identities among women and minorities.

With the increasing importance of innovation, students who pursue engineering graduate degrees often seek to build skills in conducting research (Brown and Linden, 2008). The social psychological construct of identity has emerged as a relatively new metric for assessing graduate student retention and success. Studies suggest that graduate students' identities correlate with their competency levels as well as their professional and academic motivation (Alexander, 2011; Silver, Garver, and Watkins, 2011; Virgil, 2016).

Importantly however, the literature points to deficiencies in a number of areas. First, despite a good deal of research on engineering identity at the undergraduate level, educational researchers have focused less attention on the graduate level. Choe, et al (2017), stand out as a notable exception in a report on work with graduate engineering students in a large public research university on the topic of

“Engineering Graduate Student Identity”. Relatedly, the relatively minimal research on identification as a researcher (Choe, et al., 2017; Kajifez & McNair, 2014), has largely been focused in non-engineering fields such as education and counseling (Harrison, 2008). This is important because the scant research that does exist on *engineering research identity* has pointed to the possibility that key aspects of identifying as an engineer and researcher may operate differently for graduate students than undergraduates (Choe, et al., 2017). In addition, nearly all of the research on the factors that influence engineering identity formation is qualitative, and the field is ready to begin more extensive quantitative investigations (Morelock, 2017). Lastly, within the broader literature on Identity as it relates to STEM fields in general, there are well documented reasons to believe there is a deficiency in our knowledge of black and female identities as they relate to STEM fields (Collins et al., 2018).

Theory

Identities can be defined as meanings attached to the self-concept that *position* individuals as similar or different from others within networks of relationships and organizational structures (see Burke and Stets, 2010; Walton & Jones, 2018). These self-meanings can be based in beliefs about one’s personal or individual characteristics (e.g., I can learn new things quickly), one’s role in relation to others in a group (e.g., I am a problem solver, organizer, leader), and one’s membership in broad social groups or categories (e.g., I am a black, female, graduate student). Each of these different *bases* of identity (Burke, 2003; Deaux and Burke, 2010) provide self-reflective meanings that are “built-up” from interactive processes and experiences through which individuals seek *self-verification*, or a correspondence of their identity with the feedback received from significant others. In this way, identities involve both content (i.e., the individual, role and group-based qualities and characteristics of self-beliefs), and process (i.e., self-verification).

For instance, imagine an engineering student who identifies herself as an engineer and believes that engineers are quick learners (person-based identity content) and proficient in skills such as coding or design (role-based identity content). In her classes and interactions with students and instructors, she will

seek opportunities to demonstrate her quick ability to learn and successfully write code or evaluate a design solution. When significant others (e.g., classmates, mentors, instructors, family), recognize her success, it signifies a correspondence between her view of herself (her identity) and the views others have of her. Overtime, additional self-verifying experiences will further galvanize her engineering identity, communicate to her a sense of *belonging* to the field (i.e., sameness with other engineers), and enhance her feelings of self-efficacy and motivation to persist and succeed as an engineer. However, a lack of correspondence between one's view of themselves as an engineer (identity-content) and the feedback received from others can often result in a dissonance that can prompt stress, cause one to doubt their identity as an engineer, and produce reduced self-efficacy and motivations to persist and succeed. In the example given here, such dissonance could result from the Female engineering student's real or perceived inability to quickly and successfully execute engineering tasks, but also from the lack of correspondence between the student's identity as a female and the traditional stereotypes about engineering as a normatively masculine and predominantly White field (Godwin, et al., 2016; Jorgenson, 2002).

The research presented in this paper is grounded in a novel integration of a broad range of identity theories. This integrative framework centers on three distinct elements found in a wide-range of identity theories and embodied in recent work in social psychology. Walton and Jones (2018) integrated key aspects of several identity theories to describe a form of identification that operates across the personal, role, and group-bases of identity (Burke, 2003), and involves a three part process whereby individuals (1) internalize self-meanings that position them as similar to others (i.e., sameness), (2) stigmatize personal characteristics, roles, and groups viewed as out-groups (i.e., differentiation), and (3) rank the relative importance of a given identity within the broader self-concept (i.e., centrality). Moreover, the relevant meanings attached to the self (i.e., the *content* of the identity), and *bases* of identity most relevant at a given moment (i.e., personal, role, or group-bases), are presumed to vary across different social, cultural and institutional contexts. At the same time however, the *structural process* of identity is presumed to be relatively stable (across content and bases), and ordered along the principal features of sameness, differentiation, and centrality (see blinded for review). Within this framework of

Identity, we draw upon Petroski (2010) who points out that “Science is about understanding the origins, nature, and behavior of the universe and all it contains; engineering is about solving problems by rearranging the stuff of the world to make new things”, and define Research Engineer Identity (REI) as a personal, role, and group-based identity centered on an engineer’s function of “solving problems by rearranging the stuff of the world to make new things.”

Methods

Focus Group Protocol. We developed a semi-structured focus group protocol to gain insights into the content, character, and complications associated with efforts to develop Research Engineer Identity (REI) among graduate students in general and students from underrepresented groups in particular. Before the focus groups began, we facilitated a “twenty statements test” to elicit the salience of self-meanings associated with being a research engineer. Participants were asked to write down the first twenty things that came to mind in response to the following question: “As an engineer that conducts research, I am someone who...”.

Next, we briefly informed participants about the overall goal of the study, which is to enhance the research experiences of graduate engineering students by expanding the relationship networks and cultivating a research engineer identity. We then asked each participant to provide the following information as an introduction: years in the field and a brief description of their career trajectory, how they got started in research, the type of research they conduct, and key events that influenced their research trajectory. After introductions, we facilitated the semi-structured focus group protocol (see ***Appendix A*** for full protocol). The protocol asked participants about the sameness and differentiation dimensions of Research Engineer Identity. The protocol had several objectives, including to:

- (1) uncover the extent and degree that focus group participants see themselves as similar to (or the same as) “engineers”;
 - a. determine the content and attributes of how this sameness is experienced;
- (2) obtain information about the extent and degree that focus group participants see themselves as unique within the larger category of “engineers” (within-group differentiation);

- a. determine the content and attributes of how this differentiation is experienced;
- (3) uncover the extent and degree that focus group participants see themselves as being similar to (or the same as) “research engineers”;
 - a. determine the content and attributes of how this sameness is experienced;
- (4) obtain information about the extent and degree that focus group participants see themselves as unique among “research engineers” (within-group differentiation);
 - a. determine the content and attributes of how this differentiation is experienced.
- (5) identify what types of personal attributes, role-based characteristics, and social groups/categories constitute salient oppositional others (out-groups), for focus group participants;
 - a. determine the content and attributes through which this differentiation is experienced (i.e. what are the meanings they attach to salient “oppositional out-groups”?).

Recruitment. Graduate students, faculty members, and industry professionals were recruited for focus groups using multiple methods. First, lists of faculty members and graduate students from five universities across the Southeastern United States were compiled; these universities varied based on their public or private status, their Carnegie classification (R1 vs. R2), and whether they were predominantly white institutions or minority-serving institutions. Lists of faculty members and graduate students were compiled through requests from partner institutions as well as internet searches. Second, the project team partnered with professional associations, including the Professional Engineers of North Carolina and the North Carolina Society of Engineers, to conduct outreach to their members. In both approaches, we disseminated information about the study purpose and invited individuals to fill out a web-based screening tool if they were interested in learning more about the study. The results of the screening tool were reviewed and individuals were selected to invite to participate in the focus groups. Criteria for selection included that individuals were very or moderately engaged in research as well as diversity in terms of academic discipline within engineering and demographic characteristics such as age, race, and citizenship status.

Data Collection. This paper reports on four semi-structured focus groups with research engineers that each lasted approximately 90 minutes in Fall 2019. All focus groups were audio recorded after receiving informed consent from focus group participants. Each focus group included about 6 to 9 graduate students, faculty members, or industry professionals who actively engaged in engineering research in the Southeastern United States. Focus groups were offered in-person for local participants and via webinar for non-local participants.

Data Analysis. We used audio recordings to create verbatim transcriptions of focus groups. Next, the transcripts were segmented in ways that reflected meaningful breaks in the discussion. Following Esterberg's (2002) approach to coding, we conducted open coding of the transcript segments to identify key emerging themes. We used the results of the open coding to develop thematic codes and the scholarly literature to develop theoretical codes. We compiled a codebook with one code per theme. For each code, we developed a definition as well as inclusion and exclusion criteria (Burla et al., 2008; MacQueen 1998). We used the codebook to conduct focus coding. In this process, two researchers independently coded each transcript. We ran Cohen's kappa coefficients to examine interrater reliability and ensure the quality of coding between the two researchers (Hruschka et al. 2004). We discussed all differences in coding, reached consensus on how to code each transcript segment, and recoded transcripts as needed. We then conducted content analysis to systematically analyze and identify patterns within and across codes (Mayring, 2010).

Results

Sample. Focus group participants included 30 research engineers. The majority of focus group participants (73%) were graduate students, 13 percent were faculty members, and 13 percent were industry professionals. Half of participants were male (50%) and half were female (50%). A plurality of participants were age 26 to 30 years (43%), with 27 percent being 25 years or younger, 13 percent being 31 to 35 years, 10 percent being 36 to 40 years, and 7 percent being 41 years or older. A plurality of participants were black or African American (43%). Another 20 percent of participants were Other Asian,

17 percent were Asian Indian, and 10 percent were white. Less than five percent of participants were in each of the other racial and ethnic categories.

The 22 graduate students represented various engineering disciplines; 28 percent were in industrial and systems engineering, 23 percent were pursuing mechanical engineering as their major, 23 percent were in electrical engineering, 14 percent were in computational science and engineering, 9 percent were in computer science, and 5 percent were in civil engineering. Eighty-two percent of the graduate students were pursuing their doctoral degree and 18 percent were pursuing their master's degree. About 32 percent of graduate students were in their third program year, more than one-quarter were in their fourth program year, 23 percent were in their second program year, 14 percent were in their first program year, and 5 percent were in their fifth program year (see *Table 1 next page*).

Coded Focus group analysis. Open coding of audio recordings from the focus groups allowed for the development of preliminary set of codes indicating the various self-meanings (i.e., content) of a Research Engineer Identity. These codes reveal that research engineers across the various groups shared a number of self-meanings (i.e., identity content), that signified their belonging to the broader group or community of research engineers (i.e., sameness). Additionally, the development of two codes related to the differentiation feature of identity allowed for an analysis of this important feature intergroup dynamics. The 16 codes applied to the transcript segments along with their definitions appear in *Table 2*.

Comparative Analysis. Across all focus groups, two of the most common themes included being “differentiated from others but not marked” and having “engineering knowledge and skills”. In the focus groups with male experts, the most frequent theme was being differentiated from others but not marked; sixty-five percent of the segments focused on how male experts thought that they were different from others because of how they labeled others compared to 39% for male students, 31% for female experts, and 30% for female students. For instance, one Male expert stated how...

“...research engineers... tend to work on the development side, making things better and things like that. But...when things need to get implemented, verified, and validated, and then put into

action, and eventually into making money, that's where the engineers come into play. So, that's just how I differentiate.

Table 1. Demographic Characteristics of Focus Group Participants

Characteristic	Number	Percent
Type (N=30)		
Graduate Student	22	73.33
Faculty Member	4	13.33
Industry Professionals	4	13.33
Sex (N=30)		
Female	15	50.00
Male	15	50.00
Age (N=30)		
25 or younger	8	26.67
26 to 30 years	13	43.34
31 to 35 years	4	13.33
36 to 40 years	3	10.00
41 years or older	2	6.66
Race (N=30)		
Black or African American	13	43.33
White	3	10.00
Asian Indian	5	16.67
Chinese	1	3.33
Other Asian (e.g., Persian, Arab, Vietnamese)	6	20.00
Two or More Races	1	3.33
Hispanic, Latino/a, or Spanish Origin	1	3.33
Major among Graduate Students (N=22)		
Mechanical Engineering	5	22.73
Electrical Engineering	5	22.73
Industrial & Systems Engineering	6	27.27
Computational Science & Engineering	4	13.64
Computer Science	2	9.09
Civil Engineering	1	4.55
Degree Pursuing Among Graduate Students (N=22)		
Doctorate degree	18	81.82
Master's degree	4	18.18
Program Year Among Graduate Students (N=22)		
Year 1	3	13.64
Year 2	5	22.73
Year 3	7	31.82
Year 4	6	27.27
Year 5	1	4.55

Table 2. Transcript Codes and their Description

Code	Description
“Accepting Challenges”	I/we accept challenges
“Being Creative Innovative”	I/we are creative and innovative
“Being Inquisitive/Desire to Know”	I/we are inquisitive and have a strong desire to know/understand things
“Making a Positive Impact”	I/we do what we do to make a positive impact in the world or on others
“Having an Engineering/Researcher Mindset/Perspective”	I/we have or operate from a certain mindset, perspective, or outlook
“Being Independent/Self-directed”	I/we are independent and self-directed in our work and lives
“Problem-Solver/Fixes Things”	I/we are problem solvers and fixers of things
“Having had Meaningful Past Research or Experiences”	I/we have had past experiences relevant to our research
“Having Specialized Knowledge & Skills”	I/we focus on and share some disciplinary skills and technical capabilities but also offer unique knowledge skills, and capabilities
“Working in Teams”	I/we work in teams
“A focus on People”	I/we use soft/people skills and/or focus on people in our work
“Mentoring Relationships”	I/we have or seek mentorship relationships
“A focus on Proof of Concept”	I/we focus on proof of concept and publish ideas as quickly as possible
“Managing Mental Health and Well-being”	I/we struggle with mental health, stress, and anxiety
“Marked Other”	I am/we are different from others because of how they see me (i.e., their label of me)
“Differentiated from others but not marked”	I am/we are different from others because of how I see them (i.e., my label of them)

For male experts, the second most frequent theme was having engineering knowledge and skills; in contrast, engineering knowledge and skills was the most frequent theme for all other groups. In focus groups with male experts, thirty-five percent of segments addressed engineering knowledge and skills compared to 46% of male students, 45% of female students, and 38% of female experts. For instance, one Male student stated that...

“I feel like each engineer has their own skillsets or things that they’re you know, mmm, more talented in than other engineers

These results suggest that students discussed engineering knowledge and skills at a higher frequency than experts (see **Figure 1**).

For male experts, other common themes addressed in more than one-quarter of focus group segments included (1) operating from a certain mindset, perspective, or approach (32%); (2) being creative and innovative (32%); (3) developing proof of concept and publishing ideas as quickly as possible (26%); and (4) solving problems (26%). These same themes were also common among female experts and male students, but they tended to be discussed at a slightly lower frequency. Developing proof of concept and publishing ideas quickly was one of the least common themes among female students. (see **Figure 1**).

There were differences between some of the top themes by gender. For female experts and students, one of the most common themes was feeling like a “marked other”. In the focus groups with females, nearly one-third of segments focused on how the female experts and students felt that others labeled them and treated them differently. This theme was significantly more common among females than males. Only 13% of segments in the male expert focus group and 5% of segments in the male student focus group addressed the theme “marked other” (see **Figure 1**). For instance, one Female graduate student described the following

“...in my research group...the whole group is about ten people and I’m the only female engineer. I’m the research person out there. So, well. So if any delicate things have to be handled they’ll like call me. It’s like, oh female have the tendency to handle things, to handle things like very softly.

In addition, for female experts and students, making a positive impact was a common theme and rationale for engaging in engineering. Twenty-three percent of segments in the female expert focus group and 20% of segments in the female student focus group focused on making a positive impact. This was

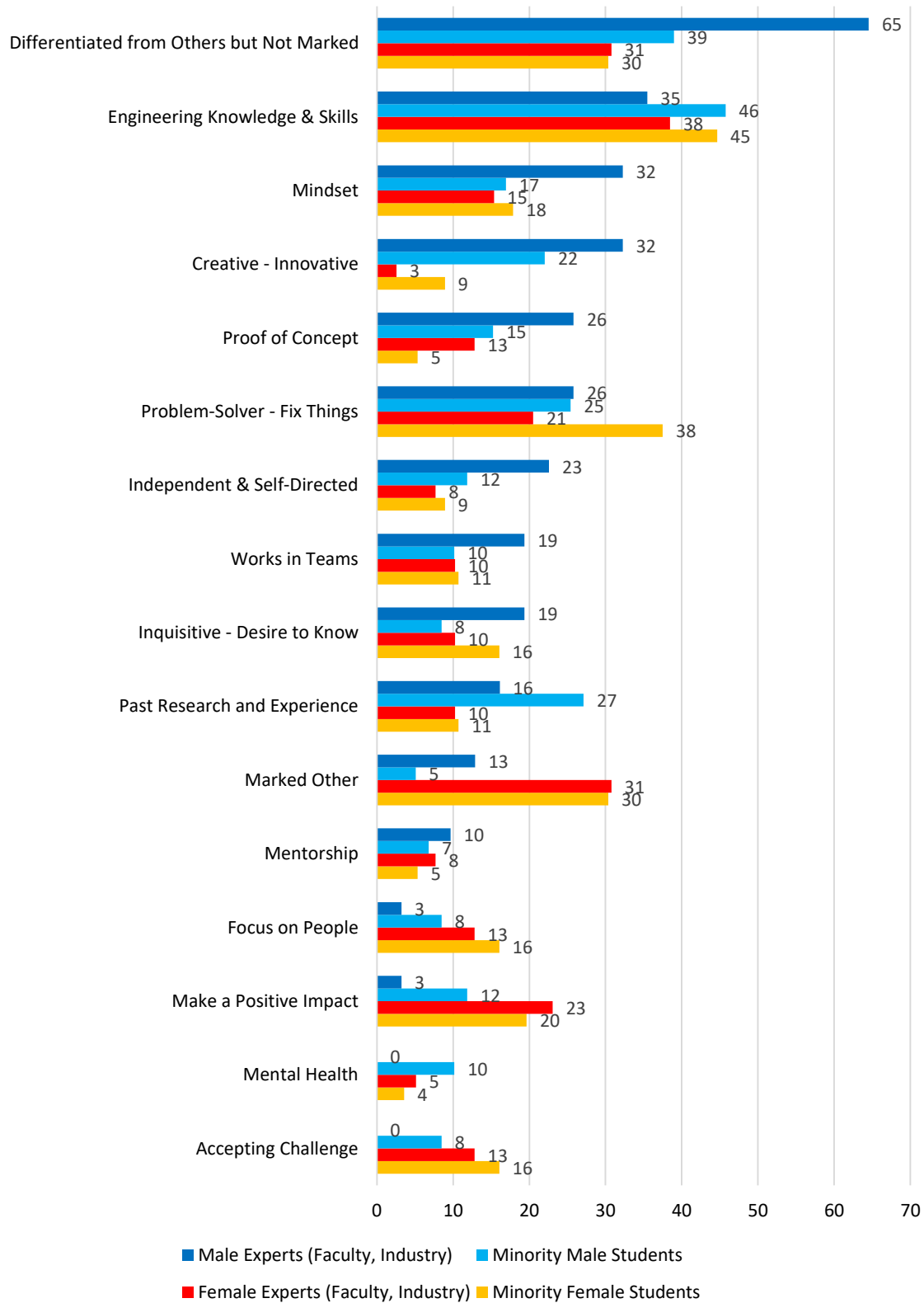
one of the least common themes in the focus groups for male experts (3% of segments) and male students (12% of segments) (see **Figure 1**). For instance, one Female expert stated the following:

“...I have a responsibility to um teach younger people about what engineering is. Um, especially those from my community who might not have an idea, who might not have access to the resources, to define what engineering is.

Importantly, mentorship was one of the least common themes across all focus groups. The limited discussion of mentorship suggested a lack of mentorship among research engineers (see **Figure 1**). Moreover, when it did come up, the conversations often times centered on a lack of mentorship. For instance, one Male graduate student describes how...

“... lot of us were kind of just thrown into it. Um, and I don't know if that's the hazing process or... a lot of professors maybe are not, you know – You received your PhD in your discipline. You didn't receive it in, you know, uh mentorship, so a lot of them are still learning themselves.

Figure 1. Percent of Segments where Themes were Referenced



Discussion

The social psychological construct of identity has quickly become one of the most effective tools for understanding different facets related to engineering education. This is likely because identity helps us understand internalized meanings attached to the self that link individuals to others through the social relationships they share. These meanings drive individual's behavior, information processing and decision-making across contexts. Although there has been substantial research on identity within undergraduate engineering, less work has been done in the research intensive environment of graduate engineering programs. Through a series of focus groups with academic and industry engineers engaged in a high level of research, this study suggests that research engineers share a set of self-meanings that define them as a group distinct from other engineers and people in their lives.

Indeed, this project worked with a diverse group of research engineers to identify 14 categories of self-meanings that constitute the content of being a research engineer. These self-meanings represent the types of qualities that graduate programs in engineering can work to cultivate within their students in order to ensure persistence through the rigors of the graduate school experience. Importantly, the findings presented here also suggest that in addition to the important role that these shared self-meanings play in helping research engineers define *who they are*, powerful differences exist within the identities and experiences of research engineers from different cultural, gender, and ethno-racial backgrounds. Indeed, despite the fact that all of the research engineers we spoke to differentiated themselves from people and groups that were not research engineers, there were strong indications that Female and Minority research engineers had experiences that caused them to see themselves as differentiated from the broader group of research engineers. This within-group differentiation appears to be grounded in fairly routine experiences as a member of an under-represented group in a STEM field. Ironically, despite the clear disempowering impact that these experiences can have, there is also some evidence that they may promote the development of alternative value structures and feelings of purpose related to STEM fields for members of underrepresented groups.

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Appendix A. Focus Group Protocol

Twenty Statements Test: In order to elicit the salience of self-meanings associated with being a research engineer, participants will be asked to write down the first twenty things that come to mind in response to the following question: “As an engineer that conducts research, I am someone who...”

Introductions: The focus group facilitator will make a brief statement thanking the participants for being willing to meet and briefly informing them about the overall goal of the NC A&T IGE project (e.g., to enhance the research experiences of graduate engineering students by expanding the relationship networks and cultivating a research engineer identity). Each participant will then be asked to provide the following information as an introduction: years in the field and a brief description of their career trajectory, how they got started in research, the type of research they conduct, and key events that influenced their research trajectory.

Sameness Dimension of Research Engineer Identity (REI)

Objective 1: Uncover the extent and degree that focus group participants see themselves as similar to (or the same as) “engineers”. Determine the content and attributes of how this sameness is experienced.

Questions:

- 1) “To what extent do you see yourself as being similar to (or the same as) other “engineers”, and if so, what are some of the ways?”
 - a. Probe: “How are these things expressed in...”
 - i. “who you are”
 - ii. “what you do”
 - iii. “what you have”
 - iv. “what you “know”

Rationale: Questions 1 and its probes are designed to elicit information about whether and in what degree participants see themselves as “professional engineers” as well as how they experience this is represented symbolically, behaviorally, and materially through what they have, are, do and know.

Objective 2: Obtain information about the extent and degree that focus group participants see themselves as unique within the larger category of, engineers (within-group distancing). Determine the content and attributes of how this uniqueness is experienced.

Questions:

- 2) “To what extent do you see yourself as being unique among ‘engineers’?”
 - a. Probe: “How is this uniqueness expressed in...”
 - b. “who you are”
 - c. “what you do”
 - d. “what you have”

- e. “what you “know”

Rationale: Questions 2 and its probes are designed to elicit information about whether and in what degree participants see themselves as different from other engineers. These questions will tap into the meanings they attach to themselves that they do not attach to “engineers”, and conversely, the meanings they attach to “engineers” that they do not attach to themselves. Lastly, the questions will illicit how the participants see this difference represented symbolically, behaviorally, and materially through what they have, are, do and know.

Objective 3: Uncover the extent and degree that focus group participants see themselves as being or being similar to (or the same as) Research Engineers. Determine the content and attributes of how this similarity is experienced, (i.e. what are the meanings they attach to both themselves and Research Engineers?)

Questions:

- 3) “To what extent do you see yourself as being or being similar to (or the same as) Research Engineers and if so, what are some of the ways?”
 - a. Probe: “How are these things expressed in...”
 - b. “who you are”
 - c. “what you do”
 - d. “what you have”
 - e. “what you “know”

Rationale: Question 3 and its probes are designed to elicit information about the degree and ways, participants see themselves as being or being similar to research engineers and how it may be symbolically, behaviorally, and materially represented and expressed in their everyday life.

Objective 4: To obtain information about the extent and degree that focus group participants see themselves as unique among research engineers. Determine the content and attributes of how this uniqueness is experienced.

Questions:

- 4) “To what extent do you see yourself as being unique from research engineers, and if so, what are some of the ways?”
 - a. Probe: “How is this uniqueness expressed in...”
 - b. “who you are”
 - c. “what you do”
 - d. “what you have”
 - e. “what you “know”

Rationale: Question 4 and its probes are designed to elicit information about whether and in what degree participants see themselves as unique within the larger category of Research Engineers (i.e. within-group

distancing). These questions will tap into the meanings they attach to themselves as research engineers that they do not attach to other research engineers, and conversely, the meanings they attach to research engineers that they do not attach to themselves. Lastly, the probes will illicit how the participants see this uniqueness is represented symbolically, behaviorally, and materially through what they have, are, do and know.

Differentiation Dimension of Research Engineer Identity

Objective 5: To identify what types of personal attributes, role-based characteristics and social groups/categories constitute salient oppositional others (out-groups), for focus group participants. Determine the content and attributes through which this differentiation is experienced (i.e. what are the meanings they attach to salient “oppositional out-groups”?)

Question:

- 5) As engineers who engage in research, are there any groups or types of people that you see as the opposite of you, or as ‘outsiders’, expressing a fundamentally different view of the world and work than you do? If so, who are some of these groups?
 - a. Probe: “What is it about... that makes them so different from you?”
 - b. “who they are”
 - c. “what they do”
 - d. “what they have”
 - e. “what they know”

Rationale: These questions are designed to elicit information regarding the types of individuals and groups that constitute salient oppositional others. Furthermore, these questions will tap into the meanings they attach to these others.

