Toward the Development of a Scale Linking Underrepresented Engineering Faculty's Workplace Experiences & Career Outcomes

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WIP: Toward the Development of a Scale Linking Underrepresented Engineering Faculty's Workplace Experiences & Career Outcomes

Although there has been an increase in the number of diverse students enrolling in engineering programs, the dismal progress in the representation of women, underrepresented minorities, and persons with varying abilities among College of Engineering faculty highlight the need for more work in this area. Given this problem, this project builds on this need by focusing on Black women engineering faculty-- a group that is one of the least represented among their colleagues. Their underrepresentation is partly explained by idiosyncrasies in their experiences that lead to varying career outcomes; existing literature highlights four salient factors. Using Messick's theory of instrument development as a methodological framework, the long-term goal of this study is to develop the Faculty Experiences & Outcomes Multidimensional Scale (FEOMS)-- a valid and reliable instrument that examines the influence of mentoring, organizational climate, incivility, and perceptions of role expectations on career outcomes and jobs satisfaction among Black women faculty in engineering. The initial draft of FEOMS includes 55 items that were modifications of items in existing scales that measured these four constructs individually. This paper presents the results of a pilot study including responses from 111 survey participants. The item analysis and polychoric correlation matrix offer preliminary evidence for the content, substantive and structural validity of the instrument. Additionally, these results link existing bodies of work by revealing empirical links between these latent constructs. Next steps for gathering additional validity evidence for the FEOMS are also discussed. Ultimately, this work will contribute to a more nuanced understanding how familiar constructs are linked and has implications for broadening participation across at all levels of engineering education.

Introduction

Although the world continues to become increasingly more diverse, this diversification is not reflected among engineering faculty. Despite an increase in the number of students enrolling in engineering and in faculty hires, the dismal progress in the representation of women, underrepresented minorities, and persons with varying abilities highlight the need for more work in this area. This project builds on existing scholarship by focusing on Black women engineering faculty (BWEF)-- a group that is one of the least represented among their colleagues. Their underrepresentation is partly explained by idiosyncrasies in their experiences that lead to varying career outcomes. BWEF are less likely than men to be employed in tenure-track positions [2], earn tenure [2,3], or become a full professor [2,3]; and the findings of a recent study report perceptions of disparities in salary and awards [2]. On the other hand, the receipt of a promotion, tenure, and professional autonomy are things that have been found to contribute to the retention of BWEF [2].

Existing literature identifies four types of factors that significantly influence their experiences and career outcomes: (1) the impact of mentoring; (2) aspects of a chilly organizational climate and acts of incivility; (3) clarifying role expectations; and (4) personal attributes. (See "Constructs Overview" for additional information.) Instruments have been developed to measure each of these constructs individually, but have not been combined to understand the impact of this combination of factors on the career outcomes of BWEF. Using Messick's theory of instrument development [9, 10] as a methodological framework, the long-term aim of this study is to develop the Faculty Experiences & Outcomes Multidimensional Scale (FEOMS)-- a valid and reliable instrument that examines the influence of mentoring, organizational climate, incivility, and role expectations on the career outcomes and jobs satisfaction of engineering faculty, especially women of color. FOES is a compilation of items pulled from existing instruments that measure the four aforementioned factors (e.g., [4-8]) and tweaked for studying these phenomena in an academic context. This work in progress paper presents the results of a pilot study, a first step toward this long-term goal.

Constructs Overview

Existing scholarship includes a variety of positive, negative, and neutral factors that impact African American women engineering faculty's (BWEF) work experiences and career outcomes. They tend to be associated with four themes: 1) personal attributes; 2) mentoring; 3) role expectations; and 4) organizational climate. This review will include a synthesis of this work and provide a basis for the development of a valid instrument for empirically studying relationships between them.

Some of the personal attributes of BWEF influence the experiences they have in the workplace and their career outcomes. Studies have shown that BWEF experience slightly higher stress than other faculty [2,3]. Time constraints on completing activities, promotion concerns, and variations in expectations contribute to these higher stress levels; this is particularly true for women of color at four-year colleges [3]. Additionally, the findings from other studies report that BWEF tend to encounter unique challenges along the tenure track [3], and have high extended family responsibility [1]. These factors can contribute to a lower self-efficacy, which correlates to feelings of institutional fit [3]. On the other hand, perceptions of institutional fit can also be positively influenced by mentoring. Before moving on to mentoring it is worth mentioning a few other personal attributes that are reported to have a positive impact on work experiences and career outcomes. They include having personal autonomy, commitments to public service and community, and a connection with a spiritual force [2].

Apart from personal attributes, mentoring tends to come up quite often in the literature on factors that influence the experiences and outcomes of BWEF. Mentoring is a relationship between at least two people that involves the exchange of instrumental insights and psychosocial support as the individuals face unique challenges and/or explore opportunities. Among BWEF, studies show that connections to early mentorship promotes success [2]. On the other hand, the absence of mentoring is also discussed in existing scholarship. More specifically, some studies point to BWEF's perceptions of little or no support, mentoring, and sense of direction [2, 3], and/or the receipt of conflicting advice from different mentors. Mentoring can mitigate some of these negative experiences. In fact, some studies have shown this mentoring has the largest and most consistent positive impact on their success [3]. Through mentorship, faculty are exposed to people that can help shape them as scholars and educators [3]. This is particularly effective when the mentors (or role models) possess characteristics with which the mentee can identify (e.g., race, gender) [3]. Some studies have found that mentoring relationships can help people overcome feelings of isolation [3]. Mentoring relationships can also provide insight on BWEF's role expectations.

Furthermore, the alignment of role expectations as presented by the leaders in an academic setting and minority faculty's understanding of them is another factor that influences BWEF's career advancement. In academia, career success is often denoted by earning a tenured status that resulted from conducted well-respected research, excelling at teaching, and/or engaging in ongoing service to one's institution and profession. Although professional autonomy is inherent in faculty roles, institutional norms and experiences beyond one's control tend to contribute to differences in how these expectations are realized in an individual's career. For example, BWEF's success may also be impeded by negative experiences in the classroom, especially those that involve majority students expressing disrespect [2,3]. More specifically, some majority students are eager to critique their minority faculty's classroom effectiveness [3], challenge their authority [3], and report concerns and critiques directly to them or his/her superior [3]. Existing studies also report that majority students perceive that minority faculty's expectations are too high or dissimilar from what their majority faculty expect of them [2]. These are examples of experiences over which minority faculty may have little control. Moreover, BWEF's success can also be hindered by institutional factors. They have reported perceived disparities in teaching assignments, space allocations, and resources as compared to their majority counterparts [2]. Compared to their colleagues, some BWEF faculty also perceive that they have greater service obligations [1, 3] and that research and service in the area of diversity are not valued as part of the promotion and tenure process. Ultimately, the lack of role clarity [3] and expectations to follow unwritten rules of university life [2, 3] contribute to BWEF's career success or

lack thereof. An organizational climate can cultivate an environment of transparency of role expectations and inclusivity. This the last factor that will be discussed in this review.

Organizational climate is defined as the values, assumptions, traditions, rituals, implicit expectations, and norms of an institution. Studies show that BWEF perceive that chilly organizational climates breed social isolation [2, 11, 12], marginalization [2, 11, 12], bias [11, 12], discrimination [3], hostility [11, 12], and lack of respect from colleagues [2]. One study showed that BWEF who chose to depart from their university tend to do so because of conflicting experiences/views on self-efficacy, role clarity, and social acceptance [3]. Social acceptance and isolation can influence one's self efficacy and institutional fit [3]. Due to BWEF experiences the compound effects of the dual oppression as both a woman and a person of color [3], they typically have to convince others, mainly the majority colleagues, that they are good enough to fulfill their role as a faculty member [2]. Even though studies have not concluded whether gender or race contribute to the effects felt from a chilly organizational climate [3], addressing these contributing factors for this type of environment can have a positive effect on BWEF's career outcomes.

Immediate next steps include pilot testing the items and performing an item analysis to ascertain each item's quality. This will immediately be followed disseminating the instrument to a national pool of Black women engineering faculty to validate the constructs and empirically test relationships between the factors and outcomes. Such insights are useful to starting a more nuanced intercontinental dialogue that will have implications for broadening participation across all levels of engineering education.

Pilot Study

Item Development

Using Messick's theory of instrument development [9, 10] as a methodological framework, the long-term aim of this study is to develop the Faculty Experiences & Outcomes Multidimensional Scale (FEOMS)-- a valid and reliable instrument that examines the influence of mentoring, organizational climate, incivility, and role expectations on the career outcomes and jobs satisfaction of engineering faculty, especially women of color. This study includes the results of a pilot study toward this end. FOEMS is a compilation of items pulled from existing instruments that measure the four aforementioned factors (e.g., [4-8]) and tweaked for studying these phenomena in an academic context. While the complete survey included a combination of item formats (e.g., fill in the blank, inserting a number of hours dedicated to routine tasks), only the Likert items will be discussed in this study. Since the original items were on a 5-point scale, all items included in FOEMS were also placed on the same 5-point Likert scale, with anchors ranging from Strongly Disagree to Strongly Agree.

Data Collection & Data Analysis

FEOMS was sent to engineering faculty at several institutions via an email including a Qualtrics® link. One hundred eleven (111) participants responded. However, only 27 participants completed the survey. An item analysis was performed to determine which survey items showed promise for completing another round of data collection with a larger sample. jMetrik is the statictical package that was used to analyze the data. The next section includes the output of the jMetrik item analysis. The bold items indicate those that would be retained in the next round of data collection due to its strong performance during this pilot study. This determination is based on two pieces of information: statistics in the Item Difficulty and Item Discrimination columns. Since the overall Difficulty ranges from 0 – 3, I look for a number that is positive, at least 0.5, preferably close to 1.5, and includes a number larger than zero for all of the options. Similarly, Discrimination statistics that are positive and are above 0.2 – 0.3 are ideal

Item Analysis Results

The overall Cronbach's α = 0.8656, which indicates a good reliability of the items. Table 1 includes the results of the item analysis associated with the overall score for each item. Thirty-five (35) of out the 49 items show promise based on the item difficulty and item discrimination. For all of the items, the item difficulty was at least 0.5, but none of the items were close to the 1.5 ideal.

Table 1. Item Analysis

Item Number	Item Content	Item Difficulty	Std. Dev.	Item Discrimination
Item Stem: *With your mentor in mind, indicate the extent to which you agree with the following statements…*				
Q1_1	I perceive myself as coachable.	4.2963	0.6068	0.0391
Q1_2	**My mentor encourages me to develop strategies for managing my life while pursuing my career goals**	**3.222**	**0.8473**	**0.5924**
Q1_3	**I have received help in developing concrete strategies to achieve my career goals.**	**3.222**	**0.8473**	**0.4055**
Q1_4	**I have been encouraged to discuss problems I face in my career.**	**3.1852**	**0.9214**	**0.5173**
Q1_5	**I have been made aware of a variety of academic career paths**	**3.1111**	**1.0860**	**0.2922**
Q1_6	**I have been encouraged to express my honest feelings concerning my experiences in the department.**	**3.2963**	**1.0309**	**0.6499**
Q1_7	**My mentor provides me with guidance on attainable academic objectives.**	**3.2593**	**0.9842**	**0.6959**
Q1_8	**I have discussed the importance of developing a realistic view of my academic career with my mentor.**	**3.1111**	**0.9740**	**0.4739**
Q1_9	**My mentor asks me probing questions so that I can reflect on my academic career PROGRESS**	**2.6667**	**0.9608**	**0.5784**
Q1_10	**My mentor provides me with practical suggestions for improving my career performance.**	**3.4074**	**0.9711**	**0.5484**
Q1_11	**My meetings with my mentor are arranged such that we are rarely interrupted**	**2.9630**	**1.0554**	**0.4316**
Q1_12	**My mentor provides me with support when I am emotionally unsettled.**	**3.1111**	**0.8916**	**0.4242**
Q1_13	**My mentor asks me probing questions so that I can reflect on my academic career PLANS**	**2.8519**	**0.9885**	**0.7403**
Q1_14	**My mentor expresses confidence in my ability to succeed in the pursuit of my career goals**	**3.8519**	**0.9885**	**0.6446**
Q1_15	**My mentor encourages me to use them as a sounding board to explore my ideas**	**3.4815**	**1.0141**	**0.5408**
Q1_16	**My mentor uses their personal experiences to provide insights relevant to my concerns**	**3.7778**	**0.9337**	**0.5991**

Q1_17	**My mentor helps me develop coping strategies when my career goals were not achieved**	**2.8889**	**0.7511**	**0.3938**
Q1_18	**My mentor encourages me to consider training opportunities that will help me reach my professional goals**	**3.2963**	**0.9121**	**0.4119**
Item Stem: *With your current department in mind, indicate the extent to which you agree with the following statements…*				
Q2_1	**People tend to get along with each other**	**4.0370**	**0.5175**	**0.3422**
Q2_2	**People take a personal interest in one another**	**3.8148**	**0.6225**	**0.6913**
Q2_3	**I feel like I have a lot in common my colleagues**	**3.4815**	**0.7530**	**0.3506**
Q2_4	**I can count on my colleagues to keep the things I tell him/her confidential**	**3.4815**	**0.7530**	**0.3996**
Q2_5	**My colleagues follow through on commitments made to me**	**3.5556**	**0.8473**	**0.2071**
Q2_6	My colleagues are not likely to give me bad advice	3.5926	0.5724	0.0821
Q2_7	I have too much work to do with insufficient time to do it	3.9630	0.8979	0.1628
Q2_8	My department is a relaxed place to work	3.2963	0.7240	0.0188
Q2_9	At home, I dread hearing the telephone ring because it might be a work-related problem	2.4444	0.6980	-0.0459
Q2_10	I feel like I have never had a day off	3.1481	1.0991	0.1274
Q2_11	At work, too many colleagues get "burned out" by the demands of their job	3.3333	0.6794	0.0337
Q2_12	**I can count on a "pat on the back" when I perform well**	**3.5185**	**0.8490**	**0.2432**
Q2_13	The only time I hear about my performance is when I make a mistake	2.6296	0.6877	-0.2995
Q2_14	**My department head communicates my strengths to me**	**3.3333**	**0.7845**	**0.3894**
Q2_15	The expectations for my job are reasonable	3.2222	0.7511	-0.1264
Q2_16	**My department head is quick to recognize good performance**	**3.4444**	**0.8006**	**0.5056**
Q2_17	**My department head uses my work as an example of what to do**	**3.4444**	**0.6980**	**0.4919**
Q2_18	**My department head is not likely to give me a hard time**	**3.8148**	**0.7357**	**0.4509**
Q2_19	**I can count on a fair evaluation from my department head**	**3.8889**	**0.6405**	**0.3469**
Q2_20	**My department head does not play favorites**	**3.6667**	**0.9199**	**0.2608**
Civility Items				
Q3_1	**My colleagues treat me with respect**	**4.2963**	**0.7753**	**0.3681**
Q3_2	**My colleagues treat me with dignity**	**4.4074**	**0.6360**	**0.3008**
Q3_3	My colleagues treat me politely	4.4074	0.5724	0.1895
Q3_4	**My colleagues are pleasant to me**	**4.2963**	**0.6688**	**0.2934**

Q3_5	My colleagues treat me with civility	4.3704	0.5649	0.1885
Item Stem: *With the LAST MONTH in mind, indicate the extent to which you agree with the following statements…*				
Q4_1	I have felt unable to control the important things in my life	2.7407	1.1298	0.0833
Q4_2	I have felt nervous or stressed	3.7407	1.1298	0.1589
Q4_3	I have felt that things were going my way	3.3704	0.7415	0.0161
Q4_4	I found that I could cope with all the things I had to do	3.2963	0.9121	-0.0903
Q4_5	I have not felt that I was on top of things	3.1852	0.8338	-0.0336
Q4_6	**I have been angered because of things that were outside of my control**	**2.7778**	**0.8916**	**0.2612**

Table 2. TEST LEVEL STATISTICS
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Number of Items = 49
Number of Examinees = 27
Skewness = -0.0688
Kurtosis = -0.3691
KR21 = 2.9253
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Table 3. RELIABILITY ANALYSIS
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Method	Estimate	95% Conf. Int.	SEM
Guttman's L2	0.8933	(0.8268, 0.9434)	4.9570
Coefficient Alpha	0.8658	(0.7821, 0.9288)	5.5601
Feldt-Gilmer	0.8778	(0.8015, 0.9352)	5.3059
Feldt-Brennan	0.8750	(0.7971, 0.9337)	5.3656
Raju's Beta	0.8658	(0.7821, 0.9288)	5.5601

In short, most of the items associed with mentoring and organizational climate performed well while the items associated with incivility in the workplace did not perform as well. In light of these results, there are two immediate next steps for the development of FEOMS. One, the items that did not perform well will be revised. Secondly, the survey will be disseminated to a larger pool of potential participants such that the survey development can continue.

Once the FEOMS is fully developed, it has the potential to be useful to both individual faculty members and to adminstrators. Invidual faculy may use it to the make connections between their current reality at any given time and their career goals, and make data-driven decisions about areas of their workplace experiences that need to be changed in order to realize different career outcomes. Furthermore, administrators may be able to use the aggregrate results from a group of faculty within their unit (deparment, college, etc.) to understand and influence the work environment they oversee, especially as it relates to mentoring, organizational climate, and civility. Collectively, this can lead to better workplace experiences and ultimately better career outcomes for underrepresented engineering faculty.

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