Development of a national survey focusing on the relationships between race, class, and gender on the persistence of women engineering faculty

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Abstract

Our study investigates the persistence of women engineering faculty in U.S. institutions with respect to the intersectionality of race, class, and gender. This investigation will be achieved through a national survey of engineering women faculty. The present paper focuses on the development of the survey. Informed by the theory of intersectionality, in this survey, race, class, and gender are explored from institutional, symbolic, and individual dimensions of oppression. This paper presents the initial process of the creation of scale items and the methodological challenges in using the concept of intersectionality for a scale/survey instrument. The survey is being systematically developed through a step-by-step process involving planning, construction, and qualitative evaluation. An extensive literature review on the persistence of women faculty has been conducted to identify concepts and constructs related to each area of interest. Future work will include additional content validation and pilot testing to confirm the validity and reliability of the instrument.

Introduction

This work in progress is part of a multi-year research project that investigates the persistence of women of color (WOC) faculty in engineering. This paper presents the initial process of creating scale items for a national persistence survey along with the methodological challenges applying an intersectionality framework to survey development. Via the development of this survey, this study will investigate the perspectives of women engineering faculty in U.S. institutions about ways that race, class, and gender impact their persistence as engineering faculty despite documented barriers facing women faculty in science, technology, engineering, and mathematics (STEM) academic fields. We anticipate that findings from our work will inform institutional and national policies and practices promoting the diversification of academic communities.

Much of existing research on women faculty in engineering has problematized the experiences of women in engineering by focusing on male dominance in the field. Among the challenges women faculty face include gender disparities and unfavorable environments that push them out of the engineering profession. Discrimination against women, however, may not be fully accounted for by gender alone, particularly for WOC who face the “double bind” of experiencing challenges as women and as people of color. Despite the acknowledgement of unique challenges facing WOC in engineering, there is a dearth of empirical research of WOC faculty in engineering. New research should explore the complex experiences of WOC across various institutional and social contexts. With growing interests in the perspectives of WOC in academic and nonacademic (e.g., Margo Lee Shetterly’s bestselling Hidden Figures book about the role of black women mathematicians at NASA) settings, this work offers a timely snapshot of the persistence of WOC, many of whom are the first or only in their professional environments.

Literature Review

An extensive literature review has been conducted to illuminate key issues and concerns in studying the persistence of the WOC faculty in engineering. The applicable literature reveals
three main components that inform the present study: (1) the issues with respect to the constructs and measurement of persistence; (2) internal and external factors that influence persistence; and (3) the methodological challenges of using the concept of intersectionality to conduct empirical research.

**Measuring persistence:** The concepts and constructs related to persistence have been explored in a variety of contexts. In a study of what makes people persist in certain goal-directed tasks despite challenges they face, Houser-Marko and Sheldon\(^9\) identify constructs of persistence to include the self-as-doer, expectancy, self-concordance and commitment. The self-as-doer construct is to link a sense of self to the process of behaving to achieve a terminal goal. Expectancy is relevant to positive future expectancies and a belief in one’s abilities. And self-concordance involves an identified motivation which makes people persist longer as they identify with terminal values. Among them, expectancy, self-concordance, and commitment can be adopted since WOC faculty in engineering with sustained motivation may be predicted to show greater goal persistence and attainment.\(^{10,11}\) Buse and Billimoria\(^{12}\) use a mixed methods approach in studying the factors related to the retention of women in the engineering profession. They first used a qualitative method to collect narratives of women through interviews. From the narratives, they argue that one’s personal vision was a contributing factor to persistence. Based upon this finding, they developed a scale to measure one’s personal vision conceptualized as the “ideal self,” which is comprised of self-efficacy, hope, optimism, and core-identity. They argue that this ideal self directly impacts work engagement, which directly impacts career engagement in engineering.

A limitation to the existing studies, however, is that they address the concept of persistence primarily from a psychological perspective. As a result, those studies tend to attribute one’s persistence to personal or psychological factors (e.g., motivation and self-efficacy) more so than social and historical contexts in which the historically underrepresented populations experience various forms of discrimination. For this reason, the existing research does not fully account for the complexity of the lived experiences of women in engineering.

**Internal and external factors affecting persistence:** Fouad and Singh\(^{13}\) identify workplace climate as not only a strong contributing factor but also an inhibiting factor to women engineers’ persistence in the profession. According to their study, workplace climate pertains to women’s satisfaction and intentions to leave or stay in engineering. The factors concerning workplace climate include the following: lack of advancement or low salary; boss or the culture; family-related reasons; personal interest and confidence in one’s abilities; and positive outcomes of one’s performance. The finding denotes that the persistence of women may be predicted by a combination of psychological factors and contextual factors. The findings also suggest that the following factors are significant for the women’s satisfaction with their jobs and careers: key, supportive people in the organization (e.g., supervisors, co-workers); recognition and valuing of their contributions to the organization; and substantial investment in their training and professional development.

Some tensions between these external and internal factors need to be explored better to ascertain constant conflicts and negotiations between the professional and personal identities of women. For instance, despite the increasing prevalence of policies supporting the advancement
of women (e.g., parental leave, “stop-the-clock”), women faculty may be discouraged from using such support because of their concerns about negative perceptions of their colleagues and administrators for needing to use such resources on the job. Some research approaches the experiences of WOC in engineering from the intersectional perspective to address such complexities. Informed by Critical Race Theory (CRT) and Critical Race Feminism, for instance, Turner, González, and Wong examine, in terms of race and gender, the experiences of WOC faculty at Predominantly White Institutions (PWIs). They report that along with the typical conditions of tokenism, communication about diversity initiatives and available resources on campuses were inconsistent and idiosyncratic.

Methodological challenges of intersectionality: In recognition of methodological challenges in constructing questions about intersectionality, researchers suggest that the questions should focus on significant constructs such as prejudice and discrimination rather than rely on demographic categories such as race, class and gender. The point of this argument is that since those categories are social constructs, a single category alone would not holistically account for the complexity of intersectionality in relation to those who experience the world at intersecting boundaries. In the same vein, McCall points out the methodological challenges of research on intersectionality because of the complexity of multiple dimensions of social life and categories of analysis arising in research practice. Bowleg also argues that additive approaches (e.g., being black and a lesbian and a woman) are in contradiction to a defining feature of intersectionality (i.e., the complexity of the intersectional social identities in relation to social inequalities). Nonetheless, Bowleg acknowledges the inevitability of the additive nature of questions about intersectionality particularly in quantitative research. Given those challenges, she argues for interpretation using intersectionality as a frame rather than creating explicit intersectionality questions in an effort to create more substantial tools for intersectionality research.

From the literature reviewed, we can draw the following implications that may inform our research inquiry and the scale/survey development. First, multiple social contexts should be considered in studying the concept of persistence to better understand the complexity of challenges faced by WOC. Most of the constructs of persistence in the existing research are more concerned with the psychological attributes and/or personal factors rather than the multiple contextual factors that may have significant relevance for the women. Second, the external factors with respect to social structure and institutions are important elements when studying the persistence of minority groups. Finally, in terms of methodological rigor, researchers need to be aware of a range of challenges in employing the intersectionality framework for a quantitative method, albeit its theoretical productivity.

With those issues in mind, the present study aims to create a scale/survey instrument grounded in the theory of intersectionality to explore the persistence of WOC faculty in engineering. The following section describes the theoretical framework of our study followed by an overview of the methodology utilized to create the instrument.

Theoretical and Conceptual Framework
Our study draws on the theory of intersectionality of race, class and gender to delve into the dynamics of the interlocking oppression faced by WOC engineering faculty. The theory of
intersectionality\textsuperscript{22,23} is useful to account for the interplay of various forms of social markedness. Particularly, our study is informed by the intersectional framework of the institutional, symbolic and individual dimensions of oppression.\textsuperscript{22,24} Institutional dimensions refer to “systemic relationships of domination and subordination structured through social institutions”\textsuperscript{22} (p. 29). These aspects are often obscured with ideologies of equal opportunity but still featured with differing degree of penalty and privilege among different groups. Symbolic dimensions involve “societally-sanctioned ideologies used to justify relations of domination and subordination” including “stereotypical and controlling images of diverse race, class, and gender groups”\textsuperscript{22} (p. 32). Individual dimensions of oppression are concerned with personal biographies affected by the institutional and symbolic dimensions of oppression.\textsuperscript{22,24} What follows is a brief description of key concepts to inform our study.

Racial oppression: Although we are focusing more on persistence than on barriers facing women and WOC in our study, racial oppression in the workplace is an area of exploration since it is widely prevalent in the existing literature. Building upon the literature, we anticipate that diverse WOC engineering faculty experience issues of race differently. We are particularly interested in exploring different ways in which race affects the lives of WOC individually (e.g., via everyday racism\textsuperscript{25,26} and structural racism\textsuperscript{27}). Everyday racism situates race as a process that exists through the everyday practices, which confirm the structural power and ideologies that define what it means to be “raced.”

Class and Socioeconomic background impacts: Class issues critically relate to equitable access to higher education and subsequent career paths of faculty in the academy. It has been well documented that social class backgrounds impact one’s sense of the self, educational outcomes, and subsequent upward social mobility and employment.\textsuperscript{28,29} In particular, class backgrounds impact the formation of a sense of belonging and identity construction,\textsuperscript{30,31} which in turn relates to one’s aspiration to be an academic and how well one might adjust to the academy, especially since it is typically populated by male faculty from middle or upper class backgrounds.\textsuperscript{28} In addition, faculty from working-class backgrounds are likely to feel that their culture is incongruent with that of the academy. Such incongruence may make them feel isolated, alienated, or ostracized. Many faculty may feel forced to compromise their values or beliefs to adjust to the academy.\textsuperscript{28,32,33}

In the U.S., race and class are highly compounded as racial discrimination entails socioeconomic impacts.\textsuperscript{28} As such, people of color often occupy a lower socioeconomic status than whites.\textsuperscript{34} By extension, we hypothesize that faculty of color from lower socioeconomic backgrounds may experience more racism compared to their white lower class counterparts or to faculty of color from middle or upper class backgrounds. Ultimately, this can result in undermining their sense of belonging in the academy.

Gender oppression: Gender is a social category constructed with respect to one’s social roles and relations. Apart from biological characteristics, there is a culture-specific perception of gender and norms concerning “what is expected, socially permitted, and valued about women and men in a particular context.”\textsuperscript{35} In engineering, women are underrepresented across all tenure-track faculty ranks (i.e., Assistant, Associate, and Full Professor) and within administrative positions. This underrepresentation has been associated with differences in hiring and promotion policies and with experiential differences in the work environment. Our survey will help us to explore how being a woman has hindered or advanced women as engineering faculty. Such an
exploration aligns with individual oppression (e.g., being discriminated against the first or only women in a department or role), symbolic oppression (e.g., being perceived as an engineering who is “too feminine), or institutional oppression (e.g., being subjected to policies that dissuade a person from being a professor and a mother).

**Persistence**: Persistence is defined as persevering despite barriers and challenges. We focus on persistence more so than barriers to distance ourselves from the deficit narrative that is often associated with faculty of color. Existing literature on faculty retention identifies some contributing factors to the persistence of the faculty such as satisfaction with teaching, a sense of accomplishment, mentoring, collegiality, level of well-being, and loyalty, and support from one’s supervisors and organizational administrators. However, many existing studies focus on institutional policies and practices to retain minority faculty in general at an institution but not specifically on individual faculty members’ personal experiences at an institution. Further, the existing work does not account for how organizational aspects impact the persistence of historically underrepresented populations in general, and WOC in particular, in academia. In recent years, however, there has been a growing body of critical studies about the faculty of color, and more specifically, WOC faculty.

Aligned with critical studies about WOC faculty, our work in progress investigates the complex and dynamic ways that race, class, and gender, among other social categories, shape WOC engineering faculty’s experiences. Persistence within our study is informed from the literature and is defined as follows:

- Working in a tenured/tenure-track engineering job (credibility/qualifications)
- Wanting to remain a faculty member in the academy (commitment)
- Being satisfied with one’s daily responsibilities (satisfaction)
- Seeing oneself as a member of the engineering and/or academic community (belonging)
- Being recognized for one’s contributions and achievements (acknowledgement)
- Developing constructive relationships with others (connection)

Given the documented discrimination against this population in the academy, persistence includes one’s being on a path to promotion and/or tenure, being tenured, and being employed full-time in an engineering unit despite the barriers and challenges these women face. We are more interested in WOCs’ persistence in academia and in the disciplines of engineering rather than their persistence at a particular institution, meaning that although a woman faculty could have transitioned across multiple institutions and departments, we are defining persistence of a woman at their current institution at the point of time in which our study is being conducted. We anticipate that experiences over time will inform how women have navigated the academy in response to the interlocking oppression of race, class, and gender.

**Method**

We aim to develop a national survey instrument investigating the perspectives of women engineering faculty on issues of intersectionality (i.e., race, class, and gender). With this instrument, we will analyze, interpret and explain issues related to women’s persistence as engineering faculty. The following research questions are guiding survey development:
• How do women faculty in engineering self-identify by race, class, and gender?
• How do individual, institutional, and symbolic dimensions of oppression connect to one’s persistence as a women faculty in engineering?
• In what ways, if any, does persistence align with these intersectionality constructs?

The instrument is being systematically developed through a step-by-step process involving planning, construction, qualitative evaluation, and validation. An overview of these phases is presented in subsequent sections.

The Planning and the Construction Phases: In the planning phase, we specified our target group as tenured and tenure track women faculty in engineering, and the purpose of the intended survey was formulated. Stages of this planning phase are briefly described in Figure 1.

![Figure 1](image1.png)

Figure 1. Stages of the planning phase, adapted from Benson and Clark’s guide for instrument development and validation

The purpose of the scale instrument is to investigate the perspectives of women engineering faculty in relation to race, class, and gender and their persistence as engineering faculty. Through an extensive literature review, the operational definitions of persistence and its constructs have been made and the components to be measured have been identified.

During the construction phase, we considered two content areas to be measured: (1) the perspectives of women engineering faculty about interpersonal relations, institutional policies and practices, and symbolic stereotypes, biases, and ideologies; and (2) the persistence of women engineering faculty with respect to challenges they encounter in terms of race, class, and gender. With the purpose in mind, we have developed a questionnaire.

![Figure 2](image2.png)

Figure 2. Stages of the construction phase, adapted from Benson and Clark’s guide for instrument development and validation

Grounded in the literature on persistence and faculty retention, we identified and adopted for our research purpose the constructs relevant to the persistence of women engineering faculty. There are several sub-constructs identified from the literature review. For our survey, the sub-constructs include racial oppression, socioeconomic background impacts, gender oppression, and intersecting challenges. For instance, racial oppression includes cultural association, work climate, one’s personal and professional network, one’s mentoring experiences, microaggressions, racial disparities, everyday racism awareness, etc. Those sub-constructs are framed within the multidimensional framework of individual, symbolic, and
institutional oppressions.\textsuperscript{22} The subdomains are various factors that may entail the complex oppressions of the intersectionality. Table 1 provides initial items across race, class, and gender, framed within the three dimensions mentioned above. (It should be noted that the items related to class were only framed within the individual dimension, since there was limited research on its interaction with the symbolic and institutional dimensions of oppression.)

Table 1. Description of sections in the survey, number of items per section, and sample items

<table>
<thead>
<tr>
<th>Survey dimension</th>
<th>Number of Items</th>
<th>Sample of race related items</th>
<th>Sample of Class related items</th>
<th>Sample of Gender related items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual</td>
<td>33</td>
<td>It is easy for me to work with most faculty outside of my race.</td>
<td>I make the highest salary in my household.</td>
<td>The majority of people in my entire professional network are people outside of my gender.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I am adequately associated with the culture of my workplace.</td>
<td>If I experience financial struggles, I can rely on others (e.g., family, friends) to help me out.</td>
<td>I often participate in a mentoring program for women faculty.</td>
</tr>
<tr>
<td>Symbolic</td>
<td>5</td>
<td>My students do not question my credentials because of my race.</td>
<td></td>
<td>People in my department would not describe me as a nurturer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I serve on committees at my university that are racially diverse.</td>
<td></td>
<td>My work responsibility does not interfere with my family responsibilities.</td>
</tr>
<tr>
<td>Institutional</td>
<td>26</td>
<td>I am not reminded of my race in my current working environment.</td>
<td></td>
<td>At my institution, women are likely to be employed in tenure-track positions.</td>
</tr>
</tbody>
</table>

The preliminary survey includes eight demographic items (i.e., race/ethnicity; education; marital status; academic rank; citizenship; gender; age; and institution type). All scale items follow a Likert scale, where respondents’ answers can range from values of “1” (strongly disagree) to “6” (strongly agree). A pool of items was written and reviewed by the research team. For the content validation, the items were given to colleagues in the field for their review. The items were revised or discarded when consensus on their content validity was not reached. We anticipate that the current survey, which includes eight demographic questions and 72 items, will undergo a series of revisions and deletions after piloting given potential survey fatigue.

Quantitative Phase: For the validation of the scale/survey instrument, we have consulted with a research methodology center at a large public university as well as with the project’s Advisory Board consisting of experts in the field. According to the feedback from those experts, we will continue to make revisions and refinements of the scale items, consolidating the theoretical foundation of the persistence scales. While incorporating the feedback into our survey
instrument developed so far, our future work will include additional content validation and pilot testing to confirm the validity and reliability of the instrument.

Figure 3. Stages of the quantitative phase, adapted from Benson and Clark’s guide for instrument development and validation

**Validation Phase:** After the scales have been piloted, some items will be deleted (low loadings, complex loadings, low internal consistency, etc.) and possibly reworded. The remaining items will become the official scale. After the survey has been revised, it may then be re-administered to a new sample. The survey is expected to be conducted between May and August 2017 and will be complementary to concurrent qualitative research in which the stories and narratives of WOC will be collected via one-on-one and focus group interviews.

**Significance**

The significance of the present study is to add to the research base that investigates from more critical social perspectives the attrition or persistence of the women faculty in engineering. Our contention is that challenges faced by the women faculty in engineering cannot be attributed merely to individual abilities or concerns but must be addressed as issues stemmed from social order. Therefore, complex social and cultural contexts should be placed at the center in addressing the persistence of the women in the academy. Our research hopes to contribute to illuminating the complexity of the experiences of the women faculty and highlighting their persistence despite the structural constraints to them.

**Conclusions**

This work in progress has the potential to add to empirical research about WOC in engineering. Using intersectionality as a frame of analysis will allow the team to define persistence from psychology and sociological perspectives. This national survey will become part of a larger mixed methods study that will inform policies for women faculty in engineering.

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