

Gendered Microaggressions in Science, Technology, Engineering, and Mathematics

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Abstract

Women remain underrepresented in both science, technology, engineering, and mathematics (STEM) workforce and academia. In this quantitative study, we focused on female faculty across STEM disciplines and their experiences in higher educational institutions through the lens of microaggressions theory. Two questions were addressed: (a) whether and to what degree female faculty in STEM fields experience various types of gendered microaggressions and (b) whether such experience differ based on participants' position rankings. Data were collected from tenured (including tenure-track) and non-tenure-track female instructional and clinical faculty in a broad range of STEM disciplines at a large Midwestern land grant research university (N=102), using two adapted instruments. The results revealed that female faculty participants experienced four different types of gendered microaggressions: sexual objectification, being silenced and marginalized, strong woman, and workplace microaggressions. Multivariate analysis further showed that position ranking did not statistically predict faculty experiences with gendered microaggressions, indicating that gendered microaggressions were experienced by women faculty regardless of the stages of their faculty career. Implications and the need for future research are also discussed.

Keywords: women, faculty, gendered microaggressions, STEM career, higher education

Female faculty in American colleges and universities experience environmental, interpersonal, and systemic barriers to their participation, academic success, and professional advancement over the course of their careers (National Science Foundation, 2013). Frequently, these occupational, environmental, and interpersonal barriers take the form of gender bias. Bias begins as preconceptions about women as faculty members and their capacity to engage in research and to perform other academic duties of the academy. Such perceptions, and their resultant offensive and oppressive behaviors, impact how women are hired, retained, and promoted. Gender bias adds an additional barrier to those academic areas where the representation of women is low, such as most science, technology, engineering, and mathematics (STEM) disciplines (Ceci, Williams, & Barnett, 2009; Preston, 2004; Rosser, 2006).

Complicating these systemic barriers are significant disparities for female students completing both undergraduate and graduate degrees in STEM areas (National Science Foundation, 2013). While women are earning college degrees in higher percentages than ever, a decline in the percentage of women earning degrees in STEM fields still exists (National Science Foundation, 2013). Such disparity persists after degree completion. Recent data show that women are underrepresented in both the STEM workforce and academia (Nelson & Brammer, 2010; Valentine & Collins, 2015). While some engineering and biological science disciplines show increased numbers of women among assistant professors (Yoder, 2014), fewer women are reaching full professor positions (Nelson & Brammer, 2010). For example, data have shown that in the top 100 departments of science disciplines, the female assistant professors in chemistry and earth sciences are 21.2% and 28.2% respectively; whereas, the female full professors in these two fields are only 13.7% and 16.5% respectively (Nelson & Brammer, 2010). Remediating these systemic barriers for women in STEM fields are of the utmost importance as the problem speaks directly to the creation of future scholars and leaders who can drive national economic growth in the years ahead (Agénor & Canuto, 2013).

This study focuses on female faculty across STEM disciplines and their experiences in higher educational institutions through the lens of microaggressions theory. According to this theory, underrepresented groups, such as women in traditionally male-dominant STEM disciplines, are most likely to experience subtle bias and discrimination based on their identities as women (Sue, 2010). This study examines (a) whether and to what degree female faculty in STEM fields experience various types of gendered microaggressions, and (b) whether such experiences differ based on participants' position rankings.

LITERATURE REVIEW

Gendered Microaggressions

While systemic sexism has become less frequent in U.S. society, subtle biases still exist and remain stubbornly so. A growing body of research has identified such subtle discrimination as *microaggressions*, which are nuanced forms of insulting, disrespectful communications that occur during everyday exchanges (Sue & Sue, 2008). Microaggressions are actions directed at individuals from various identity groups who are underrepresented or marginalized including race, gender, religion, sexual orientation, or persons with disability (Nadal, 2011; Sue et al., 2008).

Over the last fifteen years, researchers have reframed and extended microaggressions theory to examine subtle sexism and sex-based discrimination against women (Alexander & Hermann, 2016; Capodilupo, et al., 2010; Nadal, 2009). *Gendered microaggressions* are nuanced and brief everyday exchanges that communicate sexist denigration and slights toward women (Nadal, 2010) and are conveyed verbally and/or nonverbally through facial expression, gaze, and other gestures. They are subtle, often expressed unconsciously, and can cause psychological harm or discomfort toward women (Capodilupo, et al., 2010).

Theorists have proposed gendered microaggressions as a multiple-dimensional construct. For example, Nadal (2010) categorize gendered microaggressions into three forms: (a) gender micro-assaults (e.g., blatant sexist slur or catcalling); (b) gender micro-insults (e.g., subtle negative communication about women); and (c) gender micro-invalidations (e.g., subtle communication that dismisses or devalue women's thoughts or feelings). These three forms vary in their degree of subtlety, with gender micro-assaults being the least subtle, and in their level of harm, with gender micro-invalidations most harmful.

Sue and Capodilupo (2008) propose a six-dimensional gendered microaggressions model to explain the various ways that women experience such harmful, gender-biased communication. These dimensions include: (a) sexually objectifying women, (b) second-class citizen, (c) assumptions of inferiority, (d) denial of the reality of sexism, (e) assumptions of traditional gender roles, and (f) use of sexist language (Sue & Capodilupo, 2008; Capodilupo et al., 2010). Taken together, these models suggest that gendered microaggressions encompass a range of manifestations or offenses with a variety of severity and ambiguity.

A growing body of research has examined women students' and faculty members' encounters with gendered microaggressions in educational settings (Congleton, 2013;

Moors, Malley, & Stewart, 2014; Riffle et al., 2013). These studies show that gendered microaggressions cause detrimental consequences to women's psychological and behavioral health, as well as to their careers (Capodilupo et al., 2010; Crosby & Sprock, 2004). Additionally, research in clinical settings has shown that therapists' gendered microaggressions have negative influences on female clients' well-being (Owen, Tao, & Rodolfa, 2010).

Research on Gender-Based Discrimination in STEM

Researchers have examined gender-based discrimination in STEM fields using different theoretical frameworks. The most well-known theory is implicit gender bias, which is based on the assumption that women are less capable than men in math and science fields (Greenwald & Banaji, 1995; Meadows, 2013; Nosek, Banaji, & Greenwald, 2002). Implicit gender bias has been repeatedly shown to negatively influence women's: (a) intent and motivation to pursue education and careers in STEM fields, (b) employment in STEM fields, and (c) performance evaluations and career advancement in STEM fields (Beddoes, Schimpf, & Pawley, 2015; Boring, Ottoboni, & Stark, 2016; Constant & Bird, 2009; Eccles, 1987; Meadows, 2013; Steele, 1998). For example, in a randomized double-blind study, researchers found that female applicants for a science laboratory manager position were evaluated to be less qualified and hireable than when the identical application materials were submitted under a male name (Moss-Racusin et al., 2012). Furthermore, the selected male applicants were offered a higher starting salary and more mentoring than the selected female applicants (Moss-Racusin et al., 2012).

At the systematic level, researchers have looked at gender bias in the institutional environment or climate. It has been suggested that the chilly climate within a STEM work environment pushes women away from STEM fields or interferes with their thriving in these fields (Hall & Sandler, 1982). Studies find that women are seen as untrustworthy STEM experts, do not fit the STEM environment, and are either marginalized or excluded from STEM networks (Beddoes, K., & Pawley, 2013; Colyar, 2008; Hitchcock, Bland, Hekelman, & Blumenthal, 1995).

Social role theory (Eagly, 1987), as well as a number of other theories (e.g., Beach, 1990; Diekman & Steinberg, 2013; Gottfredson, 1981; Mahalik, Perry, Coonerty-Femiano, Catraio, & Land, 2006), examine gender-based discrimination from a sociological perspective. Social role theorists propose that each social position or role (e.g., mother, women) is defined by a set of expectations, norms, and behaviors. When individuals violate

social norms associated with a role, certain costs or social punishment will likely incur (Diekman & Steinberg, 2013; Eagly, 1987).

Women are expected to be nurturing, supportive, people oriented, and communal, according to social gender roles. Thus, they should be drawn to disciplines that are consistent with these gender roles, such as teaching and nursing (Diekman & Eagly, 2011; Diekman & Steinberg, 2013). By contrast, STEM fields are associated with masculine social norms such as being competitive, decisive, ambitious, risk-taking, and agentic (Yang & Barth, 2015). Thus when women enter STEM fields, they often experience contradictory expectations carried out by the scientist role (competitive and agentic) and the typical feminine gender roles (nurturing and communal), known as role conflict (Diekman & Steinberg, 2013; Yang & Barth, 2015). In other words, women who choose STEM fields are punished by violating social gender norms. This explanation has been used to explain why post-baccalaureate women leave the STEM workforce, as well as why women leaders are being evaluated less favorably than men in leadership positions (Ceci et al., 2009; Eagly & Karau, 2002; Mason, Wolfinger, & Goulden, 2013).

Gendered microaggressions is a relative new theory, but hardly a new occurrence in higher education. Not surprisingly, there are limited studies using microaggressions theory to examine gender-based discrimination in STEM fields, with only a few exceptions. Several studies have examined the experiences of women in STEM disciplines, including students and professionals in STEM careers, and found that women in general and women of color especially experience a certain type of gendered microaggressions, specifically, feeling unwelcome or excluded in STEM spaces across life stages (Faulkner, 2009; Thomas et al., 2016).

McLoughlin uses the concept *spotlighting* to understand various types of gender bias in engineering fields. Spotlighting is the act of “singling out of women by gender in ways that make them uncomfortable” (McLoughlin, 2005, p. 1). Similar to gendered microaggressions, spotlighting is multi-dimensional. Three types of spotlighting or microaggressions were found against female students in engineering. The first type is sexual objectification or overtly sexist comments that are intended to make women uncomfortable. The second type is singling out women with neutral intention, such as using the pronoun “he” generically when referring to engineers or scientists, an action that makes women feel left out or unwelcomed. The third type is singling out women with the intention to help them, a practice that infers that women are less capable, thus need additional help (McLoughlin, 2005).

Microaggressions targeted toward women occur with similar frequency and occurrence. Faculty women in colleges and universities are hardly immune to such victimization. Thus, the purpose of this study is to examine gendered microaggressions among a group of female faculty across STEM fields at a Midwestern research university.

METHOD

Participants

Data were collected from women representing tenured, untenured tenure-track, and non-tenure track instructional and clinical faculty in a broad range of science, technology, engineering, and mathematics (STEM) disciplines at a large Midwestern land grant research university. STEM disciplines were chosen since most of these disciplines (except biology-based fields) are male-dominant, and female faculty in these disciplines, as an underrepresented group, are most likely to experience and/or witness subtle microaggression and gender-based discrimination (Sue, 2010). The chosen STEM disciplines were defined by the National Science Foundation (NSF, 2012) and included Aerospace Studies, Agriculture, Architecture, Aviation Technology, Biochemistry and Molecular Biophysics, Biology, Chemistry, Economics, Engineering, Geography, Geology, Kinesiology, Mathematics, Physics, Statistics, and Veterinary Medicine. A total of 259 female faculty across multiple campuses at the institution were recruited to participate in this study.

Procedure

With Institutional Review Board approval, we acquired email addresses of potential participants from the university's planning and analysis office. An internet survey procedure was utilized (Dillman, 2000). Participants were recruited by an introductory e-mail correspondence that invited their participation. This was followed days later by the electronic survey email, a follow-up e-mail, and a final debriefing correspondence.

The data were gathered using a Qualtrics online questionnaire. On the first page of the Qualtrics questionnaire the researchers provided the consent information in written form including the purpose of the study, risks and benefits of participation, their rights as participants, and contact information should they have any questions or concerns. Faculty wishing to participate in the study continued to fill out the questionnaire at their own pace. Most participants took about 15 minutes to complete it. Upon their completion, the participants were immediately shown debriefing statements with detailed explanation of the study. Participants' responses remained confidential and anonymous.

Instruments

Our goal was to utilize existing instruments that captured the multi-dimensional nature of gendered microaggressions. While several quantitative measurements have been established to gauge individuals' perceptions of racial/ethnic microaggressions (Nadal, 2011; Sue et al., 2008), few assess women's perceptions of gendered microaggressions with the exception of Gendered Racial Microaggressions Scale (GRMS; Lewis & Neville, 2015) and Microaggressions Against Women Scale (MAWS; Owen et al., 2010). MAWS is a unidimensional scale created exclusively for therapists and counselors in counseling settings, and thus did not lend itself for use in non-clinical settings. The former GRMS is most appropriate and, therefore, was adapted for the current study.

The Gendered Racial Microaggressions Scale (GRMS) was developed to evaluate the gendered and racial microaggressions experiences of African-American women exclusively (Lewis & Neville, 2015). The 25-item instrument yields four independent factors: (a) sexual objectification (Cronbach's $\alpha = .85$), representing assumptions and stereotypes of physical attractiveness; (b) silenced and marginalized (Cronbach's $\alpha = .88$), referring to being silenced and marginalized in various settings; (c) strong woman (Cronbach's $\alpha = .74$), referring to being considered too independent and assertive; and (d) angry Black woman (Cronbach's $\alpha = .79$), representing the stereotype of an angry Black woman. GRMS has shown strong reliability and validity evidences (Lewis & Neville, 2015). Since the purpose of the current study is to examine women of all ethnic groups, we used only the first three factors: (a) sexual objectification, including seven items, (b) silenced and marginalized, including seven items, and (c) strong woman, including four items.

We recognize that the GRMS instrument does not include one dimension of microaggression that is critical to the setting of our particular study, given the socio-cultural beliefs about women in STEM disciplines, namely *workplace microaggressions*. To address this, we included another well-established instrument, Racial and Ethnic Microaggressions Scale (REMS; Nadal, 2011). REMS measures the microaggressions that people of color experience in their everyday lives and includes six independent factors: (a) assumptions of inferiority (Cronbach's $\alpha = .89$); (b) second-class citizen and assumptions of criminality (Cronbach's $\alpha = .88$); (c) microinvalidations (Cronbach's $\alpha = .89$); (d) exoticization/assumptions of similarity (Cronbach's $\alpha = .85$); (e) environmental microaggressions (Cronbach's $\alpha = .85$); and (f) workplace microaggressions (Cronbach's $\alpha = .85$). The reliability and validity of REMS has been well documented (Nadal, 2011; Nadal, Griffin, Wong, Hamit, & Rasmus, 2014), and for the purposes of the current study, items

related to race were adapted to apply to the experiences of women. For example, “An employer was unfriendly toward me because of my race,” was reworded to, “An employer was unfriendly toward me because of my gender.”

Participants were asked the extent to which they agreed with each statement regarding gender-based microaggression events on a 7-point scale (1=Strongly disagree to 7=Strongly agree). The score on each type of gendered microaggressions was calculated by averaging all items in a particular factor. It ranged between 1~7, with a higher score indicating a higher level of agreement with the experiences being addressed. Additionally, participants were asked to identify their position ranking (e.g., assistant professor, instructor, etc.).

RESULTS

Experiences of Various Types of Gendered Microaggressions

We first examined whether, and to what degree, female faculty in STEM fields experienced four types of gendered microaggressions: (a) sexual objectification, (b) silenced and marginalized, (c) strong woman, and (d) workplace microaggressions. Out of the 102 participants who completed the survey, nine participants had missing data and thus were excluded from the data analyses. Means, standard deviations, and Cronbach’s alpha coefficients are presented in Table 1.

Table 1. *Means, Standard Deviations, and Reliability Coefficient Alpha for Four Types of Gendered Microaggressions*

Type of Microaggressions	Mean	SD	Cronbach’s α
Sexual objectification	3.24	1.98	.91
Silenced and marginalized	3.74	2.07	.95
Strong woman	4.16	1.71	.88
Workplace microaggressions	3.71	2.14	.95

There are 7 items in the construct “sexual objectification;” each item is one form of sexual objectification. On *sexual objectification*, 31% of the respondents reported they had been objectified on their physical appearance or experienced stereotypes of women (had an average of 4 on all 7 items combined). In addition, 73% of women in the sample reported

experiencing at least one form of sexual objectification (e.g., a value greater than 4 on at least one item).

On *silenced and marginalized*, 76.3% of women had a confirmatory answer (a value greater than 4) on at least one of the 7 items, indicating that they had experienced at least one form of being silenced and/or marginalized (e.g., “Someone has tried to ‘put me in my place’ in a professional setting”). Nearly half (47%) of the respondents had an average of 4 on all 7 items combined, indicating that they had been ignored in a professional setting or challenged regarding their authority.

On *strong woman*, 40% of the participants reported being told she was too independent or too sassy. Additionally, 76.3% of women in the sample reported experiencing at least one comment that fits the strong-woman microaggression type (e.g., “I have been told that I am too assertive as a woman”). On *workplace microaggressions*, 44% of the respondents reported being treated unfairly at work. In addition, 68.8% of women in the sample reported experiencing at least one form of workplace microaggressions (e.g., “Someone assumed my work would be inferior to men’s work”).

Position Rankings and Experiences of Gendered Microaggressions

We further examined whether the experience of gendered microaggressions can be attributed to participants’ professional position rankings; in other words, whether or not female faculty with different position rankings differ in their experiences of gendered microaggressions. Participants’ position rankings are presented in Table 2.

Table 2. *Participants’ Position Ranking*

Position Ranking	Instructor	Clinical Professor	Assistant Professor	Associate Professor	Full Professor	Missing
Frequency	15	7	25	24	15	7
Percentage	16.1%	7.5%	26.9%	25.8%	16.1%	7.5%

All statistical assumptions were checked and have been met. A MANOVA test was then conducted on four types of gendered microaggressions using position ranking as the predictor. Since only seven participants self-identified as clinical professors, we excluded these seven cases from the analysis, given the small sample size of clinical professors. Table 3 presents the average ratings of gendered microaggressions by position rankings. The test was not statistically significant, $F(3, 75) = 1.19$, $p = .29$, Wilk’s $\lambda = .826$, $\eta_p^2 = .062$,

indicating position ranking is not a meaningful predictor of gendered microaggressions. In other words, female faculty across different levels of rankings have experienced gendered microaggressions in a similar way.

Table 3. *Means and Standard Deviations on Four Types of Gendered Microaggressions by Position Ranking*

Type of Microaggressions	Instructor	Assistant Professor	Associate Professor	Full Professor
	3.08	3.12	3.22	4.32
Sexual objectification	(1.89)	(2.05)	(2.08)	(1.77)
Silenced and marginalized	3.11	3.67	3.67	5.10
	(1.92)	(2.14)	(2.15)	(1.72)
Strong woman	4.30	3.98	3.74	4.30
	(2.11)	(1.72)	(2.17)	(1.36)
Workplace microaggressions	3.32	3.46	3.70	4.90
	(2.03)	(2.24)	(2.23)	(1.80)

Note: For each entry, means are presented on top, standard deviations are in parentheses and N is on the bottom. Scores ranged from 1 to 5, with 5 indicating higher interest.

In summary, many female faculty participants in the study reported that they experienced different types of gendered microaggressions. Furthermore, the comparison among faculty of different rankings yielded non-statistically significant results, indicating that gendered microaggressions were experienced by women faculty regardless of the stages of their faculty career.

DISCUSSION

The findings from this study provide a glimpse into the ways in which female faculty experience gendered microaggressions. Female STEM faculty did experience gendered microaggression comments that fit each of the four types of gendered microaggressions. Despite the small number of participants in this study, the fact remains that STEM faculty women do experience gendered microaggressions in their daily work environments on college campuses. The non-significant finding of using position ranking to predict gendered

microaggressions experiences has practical importance for college administrators. STEM faculty women across different stages of career rankings all experienced gendered microaggressions. This finding suggests a need for colleges and universities to examine and deconstruct the culture in which women faculty experience gendered microaggressions. If gendered microaggressions exist in campus cultures, then college and university administrators must understand how their occurrences change as women move along the professorial ranks.

Additionally, college administrators will want to know how such experiences affect female faculty's well-being and subsequent career advancement. Colleges and universities are hiring faculty in a variety of new positions, including clinical and research appointments, term [non-tenure track] faculty appointments, and adjunct positions (Chronicle of Higher Education, 2015; Selinger, 2016). Given the ways in which faculty positions are being redefined, the need for ongoing research on gendered microaggressions across all types of faculty positions in the academy is amplified.

Future research is needed to understand how faculty position, age, and race intersect to influence the occurrence and type of gendered microaggressions given the growing demographics of female STEM faculty (Nelson & Brammer, 2010; Yoder, 2014). The current study focused largely on faculty position, and the sample size was insufficient to examine other demographic characteristics.

Given the detrimental consequences of gendered microaggressions, educational institutions are increasing their efforts to disrupt the gender inequality within work and learning environments in various ways. Many institutions have institutionalized evidence-based training or workshops for faculty, administrators, and leaders; are offering informal faculty learning communities and networking; and establishing professional career coaching. Others have initiated gender equity practices in recruitment, hiring, and promotion to support and retain women through promotion and tenure process. Research on gendered microaggressions would inform colleges and universities about classroom and campus climate issues that interfere with faculty women's success and productivity. Such research is essential to help college administrators revise conduct policies and inform human capital professionals about ways to manage microaggressions in all forms.

Gendered microaggressions are complex, nuanced, offensive behaviors against female faculty that interfere with their work and create an unproductive and offensive climate. College and universities must recognize these offensive behaviors and find ways to manage their presence and frequency of occurrence so that classrooms, laboratories, and workforces remain open learning spaces for female faculty to thrive and grow.

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