

AC 2009-93: WHEN GENDER COMES INTO PLAY: FACTORS THAT DISTINGUISH COLLEGES OF ENGINEERING WITH ABOVE AND BELOW AVERAGE ENROLLMENT OF WOMEN IN UNDERGRADUATE ENGINEERING

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When Gender Comes into Play: Factors that Distinguish Colleges of Engineering with Above and Below Average Enrollment of Women in Undergraduate Engineering

Abstract

A cluster of items related to gender distinguished between the perceptions of engineering faculty members employed in eight institutions with above and below average enrollment of undergraduate women in engineering. Response patterns point to some of the challenges faced by colleges of engineering with low proportional enrollments of women.

Introduction

Investigations about the experiences of females in engineering are often framed within the context of relative numbers or proportions rather than total numbers given the fact that both women and members of other under-represented groups are often visible minorities in science, technology, engineering, and mathematic (STEM) fields. Social dynamics are shaped by proportional representation and when that proportion is highly skewed it can produce the phenomenon referred to as tokenism¹. According to Kanter's classic study, small relative numbers heighten visibility and bring attention to discrepant characteristics or ways that members of a population deviate from the norm. The effects of tokenism are most pronounced when the proportion and number of women is so small that the opportunities to participate in a community of like-minded individuals are limited. Attention to secondary characteristics like appearance, dress, and family roles are byproducts of tokenism that detract from accomplishments.

Tokenism and attention to secondary characteristics provides a partial explanation for why behaviors, such as sexual harassment, persist in some environments where women are visibly under-represented among the faculty and student body. Policies and practices that communicate concern about the under-representation of women can improve perceptions of climate and offset tensions created by tokenism².

Studies that identify environmental factors that impact the productivity and satisfaction of faculty are often framed within a body of literature about climate or culture. Climate refers to measures based in faculty perceptions and attitudes. Climate reflects culture, which has been defined as "the deeply embedded patterns of organizational behavior and the shared values, assumptions, beliefs, or ideologies that members have about their organization or its work"³. Culture is shaped by history and setting and is communicated through informal policies and practices. Perceptions of collegiality reflect an element of departmental and institutional culture that has been found to play a particularly critical role in the overall job satisfaction of female faculty members and graduate students^{4,5}.

A good deal of research in widely diverse settings has documented that women and men experience the same work environment quite differently^{6,7}. Women are significantly more

likely than men to indicate that they are leaving the workplace because of a negative work climate⁸.

This paper reports on results from a mixed methods research project funded by the National Science Foundation¹ to identify factors that distinguish colleges or schools of engineering with significantly above or below the national average of enrollment of women in undergraduate engineering. One unexpected set of factors related to departmental climate consistently distinguished between the perceptions of engineering faculty members in low- and high-enrolling colleges of engineering⁹. This was a group of questionnaire items designed to assess faculty members' perceptions about how supportive the environment was of women, there was accountability for sexist behavior within the department, and that sexual harassment issues are addressed proactively within the institution. These are factors that impact perceptions of collegiality and, as with other dimensions addressed by the research, are elements of the experiences of faculty that departmental leaders have the potential to influence positively.

This paper shares results from one part of a larger study. Data from a survey of faculty members in colleges of engineering at 8 institutions are used to answer the following research question: Are there significant differences in perceptions about gender-related elements of the university and departmental climate in colleges/schools of engineering among faculty members in universities with above and below average proportional enrollment of women in engineering?

Research Methods

The research project employed a concurrent, mixed methods research design with primary emphasis given to the quantitative data. Only results from the faculty survey are presented here. Respondents consisted of faculty members at 8 private and public institutions distributed throughout the U.S.

The original sample of participating institutions was identified using information from *2003 ASEE Profiles of Engineering and Engineering Technology Colleges*. The category of baccalaureate-granting institution was eliminated because so few graduated 50 or more women engineers in a given year. From among institutions graduating at least 50 female engineers in 2003, we labeled a group of universities as "high" where the graduation rate was significantly above the national average of 20% and "low" where 17% or less of the total number of graduates from the college of engineering were women. Among the participating institutions categorized as low enrolling, an average of 14% bachelors degrees in engineering in 2007 were awarded to women. In the high enrolling institutions, women earned an average of 24.4% of baccalaureate degrees in engineering. On average the institutions in the low enrolling category graduated a greater number of students with a baccalaureate in engineering (mean=512) than those in the high category (mean=329).

¹ Drs. Elizabeth G. Creamer, Peggy S. Meszaros, and Carol J. Burger, all of Virginia Tech, served as principal investigators on the grant.

While the original sample was more balanced, loss of institutions agreeing to participate in the study between the time the grant proposal was written and the year of implementation of the data collection, resulted in 5 high and 3 low enrolling institutions in the final sample.

Data collection procedures occurred in two phases within a six-month window. During the first phase, an institutional liaison identified by the dean of the college/school of engineering at each site worked with one of the principal investigators to negotiate human subjects clearance and to provide contact information for all full-time faculty members in engineering and full-time students from two departments identified by the institutional liaison as being the most supportive of women. The survey center at the home institution administered the on-line distribution of a faculty and student questionnaire and oversaw the follow-ups. The Center removed personal identifiers before sharing the data set of questionnaire responses for each institution.

The Engineering Faculty Survey was designed by the research team and contains 134 questions, organized in five sections: (a) Involvement with Recruiting Activities, (b) Departmental and University Environment, (c) Professional Development, (d) Involvement with Undergraduates, and (e) Personal Information. The analysis used in this paper derives from questions in Section II: Departmental and University Environment.

The second phase of data collection involved qualitative data and included a review of documents prior to the campus visit. Additional qualitative data were collected during a campus visit lead by one of the three project principal investigators. Findings from the qualitative phase of data collection are not presented here.

Results

There was only one area where a clear pattern of differences proved significant between the responses of both male and female faculty members at institutions whose proportional enrollment of undergraduate women in engineering was above or below the national average of 20%. These differences were in a set of questions related to gender and some of the behaviors associated with low representation of women, including sexist behavior and sexual harassment.

Across institutions, responses to questionnaire items indicated that faculty from the group of institutions categorized as low enrolling were significantly less likely to perceive that their environment was supportive of women than those from institutions with a somewhat larger proportional enrollment of women. There was a similar pattern of responses on questions regarding the handling and/or accountability for sexual harassment and sexist behavior. Numbers of respondents were too small to break these data down and analyze it by engineering discipline.

Table 1 demonstrates that a significantly greater percentage of faculty members at high- than low-enrolling institutions agreed or agreed strongly that the environment of the college as a whole is supportive of women. There were substantial differences by gender in responses to this question with a much higher percentage of male respondents (n=14 of 154, 48.1%) than female respondents (n=13 of 50, 26%) strongly agreeing with this statement.

Table 1. Differences between the percentages of faculty respondents agreeing that the environment in their college is supportive of women by high and low enrolling institutions.

The environment in the college as a whole is supportive of women.	High/Low Faculty Respondents	
	High (n=110)	Low (n=99)
% Reporting Strongly Agree/Agree	95.5%	85.9%
Chi-Square Test		
Pearson Chi-Square	df	Sig.
5.806	3	0.01**

* p<0.05, ** p<0.01, *** p<0.001. The full breakdown of responses is not shown because some of the cells sizes were too small.

Table 2 summarizes the results from another gender-related item in the faculty questionnaire that addresses sexist behavior. A significantly smaller percentage of faculty at low than high enrolling institutions agreed with the statement “There is appropriate accountability (penalties) for sexist behavior within my department.” As with the previous table, a significantly greater percentage of male faculty respondents (n=93 of 133, 69.9%) than female respondents (n=9 of 39, 23.1%) strongly agreed with this statement.

Table 2. Faculty responses to questionnaire item about accountability for sexist behavior, by high and low enrolling institution.

There is appropriate accountability (penalties) for sexist behavior within my department.	High/Low Faculty Respondents	
	High (n=94)	Low (n=83)
Strongly Disagree	4.3%	12.0%
Somewhat Disagree	5.3%	14.5%
Somewhat Agree	17.0%	28.9%
Strongly Agree	73.4%	44.6%
Chi-Square Test		
Pearson Chi-Square	df	Sig.
16.093	3	0.001***

* p<0.05, ** p<0.01, *** p<0.001

Table 3 provides the results of a final gender related question that addresses faculty member’s viewpoints about how proactively sexual harassment is addressed at their institution. Responses follow a similar pattern as the previous two questions with faculty members at high enrolling institutions being more likely to strongly agree than those at low enrolling institutions that sexual harassment issues are handled proactively. A significantly greater percentage of male respondents (n= 66 of 129, 51%) than female respondents (n= 6 of 32, 18.8%) strongly agreed with this statement.

Table 3. Faculty responses to questionnaire item about sexual harassment, by high and low enrolling institution.

Sexual harassment issues are addressed proactively	High/Low Faculty Respondents	
	High (n=86)	Low (n=80)
Strongly Disagree	5.8%	11.3%
Somewhat Disagree	2.3%	16.3%
Somewhat Agree	37.2%	36.3%
Strongly Agree	54.7%	36.3%
Chi-Square Test		
Pearson Chi-Square	df	Sig.
13.421	3	0.004**

*p<0.05, ** p<0.01, *** p<0.001

Discussion

The three institutions with colleges of engineering where faculty expressed significantly lower levels of satisfaction with the way administrators handled issues of sexual harassment and sexist behavior were also the same institutions where faculty perceived significantly lower levels of support for women. While there were statistically significant differences between high and low enrolling institutions in the questions related to support for women and accountability for sexual harassment and sexism, the number of faculty members expressing a high level of concern for these issues is small. It is very likely that the number of faculty members responsible for communicating a lack of respect for females is small, but that their actions and possibly institutional leaders inability to alter their behavior disproportionately impact perceptions of support for women.

Conclusions

This paper has addressed the principle research question in a single way by comparing the responses of faculty members at institutions with above and below average enrollments of women in engineering. In reality, both the proportion and number of women probably affect both men's and women's perceptions of climate. It is difficult to be sensitive to the visibility and isolation created by low proportional enrollment in a classroom, team project, or meeting in settings where it seems like there are plenty of woman on campus, if not necessarily in one's own home department.

A set of gender related questionnaire items capture one element of the environment that distinguished institutions with above and below average enrollments of undergraduate women in engineering. Results are disappointing in that they underscore that some of the unintentional effects of heightened visibility created by low proportional representation still effect the experiences of faculty members in some colleges of engineering today.

Some schools and colleges of engineering have already taken action to demonstrate a commitment to address sexist behavior and sexual harassment and to communicate concern for the low proportional enrollment of women on the faculty by proactive recruiting practices, such as those that bring young post-doctoral and research fellows to campus for talks and meetings. Programs targeted at promoting the success of women in engineering, such as those launched

by the institutions funded by the National Science Foundation's Advance program, provide a visible recognition of the unique set of challenges faced by female faculty members in engineering.

Results from the larger study indicate that even when controlling for many other individual and institutional characteristics, the proportion of undergraduate women in engineering has a significant effect on women's intent to remain in the major and men's and women's interest in pursuing engineering as a career. Some institutions with low proportional enrollments of women in engineering have found ways to offset some of the negative effects of the visibility through a culture of interactions that communicate care and respect for student's commitment to engineering. Further research will compare how the impact of some measures of institutional and departmental climate on commitment to pursue engineering varies by both the proportional and numeric representation of women. Such investigations help to identify the critical "tipping point" when the number and proportion of a visibly under-represented group no longer has such a significant on interaction patterns.

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