

**Creating Chemistry for Success: Perceived Efficacy of Activities Designed to
Advance Women in Academic Science and Engineering.**

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Abstract

This project was designed to evaluate perceived efficacy of activities found in the literature relative to diminishing structural and cultural barriers to success among Science and Engineering (S&E) women in academia. Thirty-two S&E women attended a discussion group and completed a questionnaire regarding barriers to career advancement. A five point Likert scale was used for the questionnaire to assess perceived efficacy of activities. Strong agreement was found regarding eight requirements for success. Participants also rated the effectiveness of mentoring and seventy-six percent of the participants felt that mentoring had not assisted them in attaining their career goals. Following additional content analyses of the mentoring item, three mentor-related categories emerged: the process itself, characteristics of an effective mentor, and desirable activities involved in mentoring. The results of this study can guide the practice of mentoring and the modification of policies affecting the faculty promotion process.

Introduction

Over the past twenty years the number of women entering the S&E fields as undergraduates and proceeding to graduate school has steadily increased. For example,

from 1966-1997 with the exception of mathematics and computer sciences, the percent of women entering almost every academic science area tracked by the National Science Foundation more than doubled. This data does not support the traditional assumption that women are not in the S&E academic “pipeline” and therefore cannot be found in meaningful numbers. Similar increases have occurred in the number of women pursuing doctorates. More doctorates were awarded to American women than American men in 2001-2002. Even so, in that same year more than 70 percent of professors teaching at Research 1 universities were male (Wilson, 2004). For reasons that are unclear, it appears that women are gaining the educational preparation for an academic career but are either rejected for faculty positions or are not choosing the university as their workplace (Wyer, Barbercheck, Giesman, Ozturk, & Wayne, 2001).

Speculation as to why women are reluctant to pursue an academic career includes the notion that science requires total commitment and almost “superwomen” abilities (Zakian, et al. 2003). Women report that the structure of academia does not permit individuals to balance work expectations and family responsibilities. As a result, obtaining tenure may be difficult or impossible. (Monhardt, Tillotson & Veronesi, 1999). Another view suggests that the culture of academia in general and academic science in particular emphasizes competition rather than collaboration, thereby attracting more men than women (Monhardt, et al.). These and other structural and cultural components of academic life can impede the successful recruitment, retention and advancement of women in academia.

The Harvard Report (“The study of new scholars,” 2004) further explains the origin and nature of academic career barriers. The report describes the barriers faced by

women in academia as relating to the male-oriented structure of universities as well as a culture that frequently both penalizes women and demands more of them as faculty. The institutional structure that prevails today was devised at a time when women had limited access to education, and was not intended to accommodate the unique skills and needs of women. For example, women are still largely responsible for raising children and often find themselves as caregivers to aging parents (Hopkins, Bailyn, Gibson, & Hammonds, 2002; Zakian, et al. 2003). Coincidentally, the childbearing years usually correspond with the faculty promotion process. If a woman chooses to have a child, she may delay or hinder her ability to move through the professor ranks and hence having a child becomes a career barrier.

Since the current promotion process was designed for individuals who would not bear children or had limited or no care giving expectations or responsibilities, we may witness women struggling with career choices. The care giving responsibilities of the men who designed the structure of academia were primarily the provision of financial support for dependent family members and did not have to account for childbearing responsibilities. In more recent years, some universities have initiated policies whereby the tenure clock may be stopped for individuals involved in care giving. Even though this policy may appear family-friendly, the tenure and promotion process still favors those faculty members who are able to focus their time and energy on the scholarship that will enable them to be successful within traditional expectations (Zakian, et al.). These issues in addition to limited parental leave, inadequate on-site childcare facilities and a lack of quality part-time faculty positions make an academic career seem unusually challenging and unfriendly to women. This somewhat rigid structure of academia forces many

women scientists to make difficult life choices such as waiting post-tenure to have children or deciding not to have children (Tracy, 1998). Given the prevailing notion that a career in academia is equated with a tenure track position, any individual who decides to forgo the tenure system suffers in terms of salary, career advancement and job security (Hopkins, et al.; Kulis, 1998; Zakian, et al.).

Besides the structural barriers impeding career advancement for women, cultural barriers can also act as blockades. In relation to cultural barriers, men in academic settings guide most policies, procedures and future planning activities. This male influence is particularly apparent in S&E. Not only are women minorities within academic S&E, comparatively few women reach full professor (often a pre-requisite for promotion and tenure committees) and few women hold dean or chair positions within colleges (Hopkins, et al. 2002, "The study of new scholars," 2004; Zakian, et al. 2003). The absence of women in important roles is also evident on influential departmental and college level committees that serve as major decision-making groups within universities. In S&E, men typically define scholarship and emphasize certain kinds of research as a key factor in promotion. For example, while many women scientists rely on intuition and are interested in cross-cultural issues, male colleagues tend to depend on logic and traditional methods for the practice of science (Monhardt, Tillotson, & Veronesi, 1999). This differing view of science is likely to be reflected in male-dominated committee deliberations and resulting promotion decisions that devalue the scholarship of women (Wenneras & Wold, 2001).

Another cultural barrier to success for women in S&E is their frequent, premature placement in administrative roles as associate professors. Women administrators in

academia are often the “first” and/or “only” women in a particular administrative role, causing them to feel isolated and somewhat powerless. This also means there may be no mentors or role models for these women. In addition, these administrative duties limit their research time, often preventing them from reaching the rank of full professor (Wenneras & Wold, 2001). Well-meaning senior administrators may ask a capable woman to fill an administrative role without considering the negative impact on the eventual success of the individual in terms of proceeding through the professor ranks. A woman who wants to be a leader, advance through the professor ranks and fulfill the expectations of their senior administrator, may feel conflicted about choosing an administrative role.

The two final cultural barriers women may face include evaluations of scientific merit and stereotypical attitudes. Women are often required to have more publications and national recognition than their male colleagues as a prerequisite to promotion (Olson, 2002). An example of inequitable evaluations of scientific merit occurred in Sweden. Sweden is viewed by many as a country that supports gender equity as much or more than other areas of the world. In 2001, Wenneras and Wold published a study examining the peer review system of the Medical Research Council (MRC), the major funding agency for biomedical research in Sweden. The specific aim of the study was to determine if men and women were evaluated equally. The investigation was prompted by the fact that the success rate for women had been less than half of the success rate for men throughout the 1990's. Results showed that peer reviewers did not judge scientific merit independent of gender. Male achievements were overestimated and/or female achievements were underestimated. This study in Sweden elucidates how women in S&E

academia may experience evaluation inequities and thus are not promoted and/or do not attain tenure.

According to anecdotal data (Zakian, et al. 2003) stereotypical attitudes toward women in S&E persist in many colleges and universities throughout the country. Most of these negative biases relate to care giving and childbearing. For example, quotes from the Princeton Report include “childcare is not compatible with success in S&E”; “even if an assistant professor takes an extension of the tenure clock (for child-bearing) it will be ignored;” and “it is difficult for women to succeed (in S&E) and have children.” Perhaps as a result of a “chilly climate” in academic S&E for women who have children, job satisfaction for women tends to be lower for women than men. At MIT (Hopkins, et al. 2002) 60 matched comparisons were studied showing that 39% of women were “very satisfied” as compared to 63% of men. These stereotypical attitudes and low satisfaction rates may be present because of the low representation of women in S& E and the minimal changes that have been made in the structure and culture of academia.

The identification of both structural and cultural activities has cultivated numerous initiatives to remedy inequities. While numerous activities have been initiated to increase work satisfaction, enhance success and retain women in academic S&E, few outcome studies have been conducted. The research in this area has focused largely on identifying the impediments to success (Rosser & Lane, 2002; Hanson, Fuchs, Aisenbrey, & Kravets, 2004). In addition, the most important participants in any investigation – the women themselves - have not been asked to identify those activities that, from their perception, would be most likely to assist them with their careers. This gap in the literature forms the foundation for this study. The intent of this project was to provide

evaluative data regarding the efficacy of activities suggested in the literature as a means to furthering the careers of women faculty in S&E.

Methods

Multiple methods were used to better understand activities that would most likely promote success among women in academic S&E. Thirty-five women met to discuss cultural and structural barriers to recruitment, retention and advancement within their university. One hundred six women in S&E were invited to attend giving a response rate of 33 percent. Five women faculty of color attended constituting 29% of women faculty of color in S&E. Participants responded to a 24-item questionnaire (9 items on structural barriers, 15 on cultural barriers) by identifying their level of agreement that the activity would be effective (see Table 1). A five point Likert scale was used to determine level of agreement (1 = strongly disagree to 5 = strongly agree). Participants were also asked to identify whether or not they would be willing to be involved in the activities they were rating.

Activities suggested in the questionnaire were derived from the literature on women scholars in S&E (Rosser & Lane, 2002) and/or were based on discussions with successful (full professors, administrators) S&E women prior to the meeting. A comments section was available with each item and additional concerns were requested at the end. Participants also completed an open-ended questionnaire related to their experiences with mentoring. Mentoring is repeatedly discussed in the literature as a mechanism for promoting success (Moody, 2004; Muller, 2000; Grant & Ward, 2000; Schwiebert et al, 2003; Quinlan, 2003; Murphy & Ensher, 2001). Unfortunately, specific models that will enhance the success of women in academic S&E have not been tested.

This information was requested in order to design a mechanism that would be most helpful to this population.

Following the completion of the questionnaire, participants discussed their concerns related to structural and cultural barriers in small groups for one hour. Using an interview guide, facilitators from the university's President's Commission on Women began by asking participants what initiatives would be most helpful to their success at their institution. Facilitators recorded the discussion in their groups and these data were analyzed for themes. Three independent sources were used to identify themes. Agreement on each theme ranged from 88% to 96%.

Reporting the results of this study may enable faculty and administrators on other campuses to a) gather similar data from women in S&E, b) test recruitment, retention and advancement models based on this kind of information, c) study further the effects of specific models of mentoring and d) examine the underlying reasons regarding the need for specific interventions for women as opposed to men.

Results

Table 2 shows the results of the questionnaire. Activities receiving a mean score of 4 and above can be divided into three categories: direct support for scholarly pursuits (egs. financial support for laboratories, summer projects, grant writing seminars); recognition and support of care giving needs (egs. improve childcare, stop the tenure clock for care giving); and improvement of the structural pieces of the system (egs. promotion and tenure committees, search committees). Education in relation to equity of those individuals who can assist women in academic S&E was perceived as very important. Understanding barriers by assessing gender equity indicators and conducting objective

exit interviews was also a priority. Desire to participate in these activities varied from 25% to 74% and may have been a function of the individual's career path (eg. some participants did not have children or their children were grown and they would not be interested in participating in those activities).

Three themes emerged from the small group discussion data: accurate information, system structure and climate. Participants conveyed a concern that accurate information regarding the barriers faced by women in S&E might not be available. They were aware of numbers of anecdotes but could not find systematically collected data on specific barriers. They expressed a need for universities to regularly collect and make public data on gender inequities. Two primary concerns emerged including equity in terms of salary and allocation of resources and time.

As evidenced by the questionnaire data these participants felt that the structure of the rewards system within academia was in direct opposition to child bearing and child rearing. As stated in the Princeton Report, even if the tenure clock is stopped, some faculty will not review their peers fairly. There was also the perception that the university system tended to favor men in terms of resources i.e. laboratory space and doctoral assistants. In terms of climate, negative attitudes toward care giving (children, elderly) as well as the role of women in academia were thought to be a major point of dissatisfaction for women in S&E. Education of faculty and administrators was viewed as an important intervention related to changing this "chilly climate."

Data on mentoring showed that 72 percent (18, n=25) of those participants who had experienced mentoring disagreed that it had been effective in assisting them to be successful. Twenty-eight percent (7, n=25) of those mentored agreed mentoring was

helpful in advancing their career. Twenty-nine percent (10, n=35) of all participants had not had a mentoring experience. Fifty-four percent of all participants (19, n=35) agreed that administrators, mentors and new or junior faculty needed to be educated as to the role and purpose of the mentor. Thirty-one percent (11, n=35) of participants agreed that mentoring needs to be strongly supported by university senior administration and that at least one mentor needs to come from the specific discipline and/or the research area of the person being mentored.

Discussion

This study undertook a closer evaluation of the current activities designed to assist women faculty advance in the science and engineering fields. Instead of focusing solely on the barriers to success for these women, the study's aim was to identify and document the effective characteristics of career advancement activities. The data collected in the present study support the notion that women S&E faculty on this campus want direct support for their scholarly pursuits, understanding of care giving needs and in some instances assistance with those needs.

In relation to scholarly pursuits, there was a strong indication that the traditional structure of academia may itself be a barrier to success for many women. For example, research productivity during childbearing years may decline because the tenure clock coincides with those years for most women. Reactions were mixed regarding the proposed option of modifying the clock based on care giving needs. Some women did not want "special" treatment and they were also aware that anecdotal evidence suggests that some members of promotion and tenure committees will not take extensions of the tenure clock into account when making promotion decisions. This modification of the tenure

clock has been presented in the research literature as a method for assisting women advance through the ranks, however the actual implementation of the method appears ineffective.

While women were clearly concerned about the potential mismatch between care giving and an academic career they also wanted more information about potential barriers to promotion as well as strategies that promote success. Comments in small groups included “I didn’t know how to put a dossier together”, “I wasn’t sure what our promotion and tenure committee wanted”, and “my male colleagues seem to understand the system better than I do”. This lack of understanding/information may relate to the perception on this campus that for the most part, mentoring as established, has not worked. Participants concluded that one or more mentors are needed within the area of their expertise to assist them to be successful in their scholarly work and to effectively guide them through the promotion process.

Two immediate recommendations that emerge from this study are 1) design a system of mentoring that meets the needs of faculty as they move through the ranks and 2) propose a modification of the tenure clock for men and women based on care giving needs. The mentoring system will be devised so that areas of expertise as well as guidance through the system are addressed. Education of all promotion and tenure committee members must accompany the proposed possibility of modifying the tenure clock so that the extension is considered during deliberation of the faculty member’s performance.

Identification of prominent themes and acknowledgement of successful strategies are the first of many steps to removing structural and cultural barriers that hinder women

from success in S&E academe. The assessment in the present study was conducted to collect quantitative and qualitative data in preparation for the development of a campus-wide program focused on the advancement of women in S&E. The collected data provides specific interventions to be infused into the departmental and collegiate level environments as well as all-encompassing campus policies. The advancement of S&E women is important on the individual level, but also adds to the success and prestige of the institution itself through the creation of an environment that fosters creative, productive researchers.