# PROMOTING GENDER EQUITY IN ACADEMIC DEPARTMENTS: A STUDY OF DEPARTMENT HEADS IN TOP-RANKED CHEMISTRY DEPARTMENTS

*Jean Stockard,[1] Jessica Greene,[1] Priscilla Lewis,[2] and Geraldine Richmond[2]*
[1]*Department of Planning, Public Policy, and Management,* [2] *Department of Chemistry, University of Oregon*

*Although the proportion of doctoral degrees in chemistry that have gone to women has increased markedly over the past few decades, the representation of women among higher education faculty has not increased at the same rate. This paper reports the results of a systematic effort to change this pattern by increasing the commitment of department heads in leading departments to the hiring and support of women faculty. Results indicate that participants in a carefully planned intervention changed their attitudes regarding reasons underlying women's underrepresentation and barriers to their progress in the field from pre- to postworkshop. Participants also reported commitment to change immediately after the event and engaging in a number of specific change efforts in the following months. While the quality of these change efforts was not related to changes in attitudes, those with fewer women in their department were more likely to report more fully on change efforts.*

## INTRODUCTION

The representation of women among faculty in higher education has been a focus of research for many years. Earlier authors directed most of their attention to women's underrepresentation among both recipients of advanced degrees and members of the professoriate (e.g., Astin, 1969; Rossi, 1965). Over the last half of the twentieth century, however, the situation changed markedly. In both 1950 and 1960, women earned only 10% of all doctoral degrees awarded in the United States, but by the turn of the new century they earned 45%. Similar changes occurred among higher education faculty. Women comprised 25% of all faculty members in higher education in 1950 and 22% in 1960, but by 2004 this figure had almost doubled to 43% (National Center for Education Statistics, 2005; calculated from tables 246 and 169).[1]

While these aggregate figures indicate substantial change, the progress has not been uniform. For instance, numerous studies have found that women are more likely to be employed at institutions that do not offer doctoral degrees and, among doctoral degree-granting institutions, to be employed at those with less prestige (Fox, 1995; Long, 2001; Xie & Shauman, 2003; Zuckerman, 1991). In addition, disciplines vary in the extent to which faculty ranks reflect the pool of available women candidates. In areas where doctoral recipients have employment opportunities in a variety of sectors, such as economics,

---

[1]In earlier decades, women earned proportionately more doctorates than in the 1950s and 1960s. Fifteen percent of all doctorates awarded went to women in 1920 and 1930, and 13% in 1940. In addition, women comprised more than a fourth of all higher education faculty from 1920 through 1940 (calculated from Table 169, National Center for Education Statistics, 2005; see also Stockard et al., 1980, for a more extensive discussion of this area).

Correspondence concerning this article should be addressed to Jessica Greene, Department of Planning, Public Policy, and Management, University of Oregon, Eugene, OR 97403; telephone: 541-346-0138; e-mail: jessicag@uoregon.edu

engineering, medicine, and chemistry, women have been underrepresented in new hires in academe relative to their representation in the pool of possible candidates (Bickel, et al., 2002; Kuck, Marzabadi, Nolan, & Buckner, 2004; McMillen and Singell, 2001; Morrissey, 2006; Singell and Stone, 1993; Stewart, LaVaque-Mantry, & Malley, 2004).

This paper reports on a systematic effort to promote change in this area by enhancing the commitment of leaders in one discipline, namely, academic chemistry, to the hiring and support of women faculty. We examine changes in attitudes that occurred over the course of a workshop, commitments to change expressed immediately after the intervention, and, finally, concrete measures taken to promote change in the months following the workshop. Our results suggest that carefully planned interventions can change attitudes and promote commitment to gender equity among key decision makers. We discuss the unique aspects of this workshop and how it might be replicated in other areas of higher education in which women remain underrepresented. Our results inform both policies regarding increasing diversity in higher education and theories regarding how changes may be encouraged.

## BACKGROUND

Women's underrepresentation in academic chemistry is well documented. For instance, at the 50 schools with the highest chemistry research expenditures, 31% of all doctorate degrees in chemistry awarded between 1993 and 2002 were given to women. Yet, in 2003 only 22% of assistant professors were women, the rank at which the newly minted Ph.D.s would be hired, and only 12% of all full professors (Nelson, 2005) were women. Women are especially underrepresented in the top-ranked departments (Kuck et al., 2004; Marasco, 2006; Morrissey, 2006).

Studies of the climate within academic departments including, but not limited to, chemistry indicate that when gender differences occur, women faculty are significantly more likely than men to report negative experiences, unfair treatment, and being less satisfied with their positions. Women's lower levels of satisfaction and negative experiences, such as exclusion from networks and support, are related to a greater tendency to leave academe and to lower productivity. Several authors suggest that continuing experiences with this negative gender climate cumulate through a "weathering" or "cascading" process, which can exacerbate issues associated with women's underrepresentation (Bronstein & Farnsworth, 1998; Etzkowitz, Kemelgor, & Uzzi, 2000; Settles, Cortina, Malley, & Stewart, 2006).

It is reasonable to assume that students observe these conditions during their graduate careers. In fact, studies of graduate students suggest that among those in mathematics and the sciences, women are more likely than men to have concerns about the academic lifestyle and to alter their aspirations away from academic research careers [Sears, 2003; see also Van Anders (2004) for a similar study of students in a broader range of disciplines]. Thus, those who are concerned with women's relative absence from academic careers in areas such as chemistry suggest that it is important to address the negative gender climate within academic departments.

Contemporary analyses of the reasons that underlie a negative gender climate focus on social cognitive processes using the notion of gender schemas, sets of "implicit, or

nonconscious, hypotheses about sex differences" (Valian, 1999, p. 2). Psychologists suggest that schemas are a natural and essential cognitive process that humans use to help make sense of the world. When, however, these schemas include elements that involve perceptions, however slight, of differences between groups, they can accumulate to the disadvantage of one or another of those groups. This, suggest contemporary writers, is the situation that best typifies academic departments. As Valian puts it, "Most men and women in the professions and academia explicitly, and sincerely, profess egalitarian beliefs....[Yet], our interpretations of others' performance are influenced by the unacknowledged beliefs we all—male and female alike—have about gender differences" (Valian, 1999, p. 2). These beliefs can influence the day-to-day interactions between men and women in the workplace, perceptions and expectations, evaluations, and social relationships. Even small differences in how women are evaluated and treated can cumulate over time to a situation that is perceived as unfair, and to a negative gender climate (Bielby, 1991; Fox, 1991; Valian, 1999, 2005).[2]

Several authors stress that a key focus of efforts to change the negative gender climate should be leaders within academic departments. Settles et al. (2006) found that leadership of the department was a significant influence on women faculty members' job satisfaction, perceived influence, and reports of productivity, independent of their individual experiences of sexual harassment and gender discrimination. Although they studied private sector business employers rather than academic departments, the findings of Kalev, Dobbin, & Kelly (2006) also support this conclusion. In an extensive quantitative analysis, they found that organizations that established organizational responsibility for diversity were the most effective in increasing the representation of women and minorities [see also Rynes & Rosen (1995)]. In general, given their structural location between faculty and higher administration, as well as their ability to influence discussions and actions within a department, department heads are seen as crucial players in any attempt to develop change [see Bickel et al. (2002), Bronstein & Farnsworth (1998), Etzkowitz et al. (2000), and Golde (2005)].

Evidence about the characteristics of programs that are effective in reducing prejudice and stereotyping comes from work with students related to diversity issues as well as work within the human resource tradition (Cotton, 1993; Kalev et al., 2006; Naff & Kellough, 2003). In general, the literature suggests that certain practices are ineffective or, worse, can backfire by antagonizing learners and increasing tensions between groups. These ineffective practices include message films and plays that are perceived to be propagandistic in nature, and human relations training and direct antiprejudice lessons, especially when they are required. Practices that have been found to be effective in reducing prejudice and increasing empathy include dramatic presentations that illustrate how prejudice is unfair and harmful, print media that portrays cultural groups positively, counterstereotyping efforts focusing on characteristics of stereotyped groups that counter popular stereotypes, the development of critical thinking skills, and programs to increase self-esteem.

---

[2]Earlier analyses of negative gender climate used the concept of gender "stereotypes," which tends to carry the implication that the views are negative and in error. The term gender schema is seen as more inclusive. See Stockard and Johnson (1992), Stockard (1999), and Valian (1999) for a discussion of changes over time in the use of these terms.

More generally, many decades of research provide support for the "contact hypothesis," initially developed by Gordon Allport. This hypothesis suggests that prejudice will be reduced and positive relationships enhanced when members of different groups work together in situations where they have equal status, get to know each other as individuals, and have common interests and similar characteristics, and where social norms are favorable to their association, circumstances favor cooperation, and individual and group goals can be advanced through cooperation. (Allport, 1954; Blalock, 1967; Blalock & Wilkin, 1979; Miller & Brewer, 1984; Moskos & Butler, 1996). Practices that have been reported as effective tend to build on the tenets of this approach (Muthuswamy, Levine, & Gazel, 2006; Springer, Palmer, Terenzini, Pascarella, & Nora, 1996), although at least one study suggests that producing long-term change may be difficult (Hill & Augoustinos, 2001).

The workshop that we examine in this article explicitly addressed issues related to negative gender climate within academic chemistry through an intervention with selected department heads. The intervention was designed in ways that, theoretically, could help make it more effective and acceptable to participants and thus enhance commitment to gender equity. For instance, it was designed to build on favorable relationships and perceptions, providing research evidence of both the lack of women in faculty positions and the reasons for their underrepresentation. Strong support of prestigious groups, including funding agents and representatives of highly regarded departments, was a component that was included, providing legitimization for the effort. In addition, aspects of both chemistry as a field and characteristics of the department heads could be expected to enhance commitment to gender equity. For instance, many of the elements central to the contact hypothesis are present: most research labs include both women and men, at least among graduate students, who work in cooperative situations toward common goals and with, at least among students, relatively equal status.[3] Finally, it could be expected that the department heads would have characteristics cited by the literature as reducing prejudice and enhancing the acceptance of egalitarian ideology, with high self-esteem and, given their scientific training, habits and skills of critical thinking [see Hart & Lumsden (1989), Mabbutt (1991), Pate (1981, 1988), and Walsh (1988) for examples of literature in this area]. On the other hand, there were elements that could, according to the literature, promote backlash and resentment, such as a perception that the workshop was "required" and, conceivably, perceptions that the content was "propagandistic" in nature. Below we give more details of our methodology.

---

[3] The tenets of the contact hypothesis do not imply that interpersonal competition is absent. Many of the classic examples of the contact hypothesis, such as sports teams, work organizations, and army troops, include elements of interpersonal competition—for playing time, salary, and higher service ranks. At the same time, individuals in these groups work together for a common goal, whether it is victory on the sports team, in the marketplace, or on the battlefield. We suggest that scientific labs may resemble this situation with individual members competing for status or recognition with their peers, but united in their broader research agendas. It is the opportunity to see and recognize the scientific competence of others, in this case women, that is central to the applicability of the contact hypothesis. In addition, it is not necessary for the inclusion of a minority group to be complete or consistent throughout a field for the contact hypothesis to hold. For instance, the history of racial integration has demonstrated the important role of "pioneers," such as the baseball player Jackie Robinson, in breaking color barriers. Contact with these "pioneers" is viewed as providing the first steps in promoting contact and altering prejudice.

## METHODS

### Procedures and Participants

The primary participants in the study were chemistry department heads who participated in a carefully designed workshop designed to increase their awareness of issues related to gender equity in the sciences and their commitment to change. Secondary participants were women academic chemists.

*Department Head Workshop to Promote Gender Equity.* The "Workshop on Building Strong Academic Chemistry Departments through Gender Equity" was held in late January, 2006, over two and one-half days (Sunday evening through Tuesday afternoon) in a hotel in the Washington, DC, area. The workshop was sponsored by three federal agencies that provide the vast majority of research funding to chemists in academia: the National Science Foundation (NSF), the Department of Energy (DOE), and the National Institutes of Health (NIH). A steering committee composed of representatives from these agencies and six chemists from leading institutions around the country planned and coordinated the program.

Department heads from the 69 academic chemistry departments that receive the most federal research and development money and/or produce the largest number of Ph.D. students were invited to the workshop. The organizers felt that it was important to focus on these departments because of their prominence within the field, their potential to serve as both models and leaders for other departments, and the extent to which they could influence large numbers of students. Consistent with women's representation in chemistry departments nationwide, women were, on average, about 14% of the tenure-track faculty in the represented departments (Marasco, 2006). When non-tenure-track faculty were included, this figure increased slightly to 18%.

All expenses for attending the workshop were paid by the funding agencies, and department heads that were not able to come could send a faculty representative. Contacts to encourage attendance were made by both the program officers from DOE, NIH, and NSF and from members of the steering committee. These extensive outreach efforts were very successful, with 56 of the departments (81% of those invited) having either the head or, in a very few cases, a representative in attendance. Conference organizers reported that attendance at sessions throughout the conference was very high, and suggest that this could have been motivated by the continual presence of representatives of the funding agencies.

Attendees were required to complete a questionnaire that examined their attitudes and perceptions regarding women's representation in chemistry before attending the workshop, and were also asked to complete a questionnaire on the same topics after the conference was over and they had returned to their home institutions. The questions involved their views about women's representation in academic departments and addressed issues covered in the workshop sessions. The questions were reviewed by an expert panel composed of workshop steering committee members, all of whom had extensive experience with and knowledge of the issue. Thirty-nine department chairs completed both the preworkshop and postworkshop questionnaires (response rate of 70%). Of those who provided demographic information ($n = 38$), four were nonwhite and four were women. All but three were the current chair of the

department. One of these three people was an associate chair, and the other two were past chairs. They reported serving in their positions from less than a year to over 12 years, with an average tenure of 3.2 years. They ranged in age from 40 to 66, with an average age of 52.

The workshop was designed to develop awareness of the problem of women's underrepresentation in academic chemistry, to motivate leaders in the field to work for change, to develop concrete steps to address the inequities, and to obtain commitment from participants to seek change. Sessions on the first evening of the workshop described the demographics of the chemistry profession, focusing on the disparity in the gender composition of the pool of doctoral recipients and the chemistry faculties. This was followed by a theater performance by the University of Michigan CRLT Players, a well-known acting group that specializes in sketches that can engage faculty in relation to issues regarding equity and institutional climates (http://www.crlt.umich.edu/the-atre/theatre.html). The players were commissioned to provide sketches on mentoring, faculty hiring, and the tenure decision process in order to help sensitize participants to the issues that were introduced in the preceding presentation and that would be addressed more fully in the following two days. In addition to these dramatized scenarios, several prominent women chemists described the difficulties they had experienced in their departments and institutions because of being a woman.

The morning of the second day included presentations on two issues: (a) the nature of subtle biases and prejudice and how they can influence hiring decisions and (b) challenges and opportunities related to gender equity within departments and universities. Speakers were well-known social and behavioral scientists, physical scientists, and university administrators. In the afternoon, the attendees were divided into 10 small groups, each with a designated leader and reporter, and with a specific charge. In the first breakout session, five groups were charged with identifying challenges that departments and research centers face in working toward eliminating biases that impede recruitment and hiring of women, and five groups were charged with identifying challenges affecting retention and promotion of women. Following reports from the groups, a panel of professors from leading chemistry departments from around the nation discussed the recommendations, relating them to knowledge regarding best practices in promoting equity. The panel discussion was followed by a second set of break-out sessions in which participants were charged with developing recommendations for institutional changes that would increase the presence of women. Five of the groups focused on institutional policies related to recruitment and hiring and five on policies and procedures related to retention and promotion. Another panel discussion, again with representatives from around the country, responded to these recommendations.

The final day of the workshop examined challenges and opportunities related to funding agencies. It began with presentations by a U.S. senator on Title IX and legislative issues related to equity, by the director of equal opportunity programs at NSF, and a panel discussion of several funding agency directors important in funding chemists. This was followed by break-out sessions that focused on recommendations relevant to the three sponsoring funding organizations and, as on the previous day, a panel that responded to the reports of these break-out sessions.

At the conclusion of the workshop, the department chairs were charged with returning to their departments and working with faculty to identify and commit to two or

more action items from the list of recommendations developed during the workshop. A short anonymous evaluation form completed on this last day asked the chairs to describe these commitments.

The chairs were also charged with reporting on their decisions and progress on an interactive Web site that could be accessed by all participants and thus was not anonymous. It was envisioned that the Web site would provide a forum for department chairs to share information and strategies, post questions, and interact confidentially with other department heads on issues related to increasing diversity and equity in their departments. The chairs were asked to report on the action items that they had chosen to pursue and any progress that had been made on these efforts.

*A Comparison Group of Women Faculty.* Given the nature of the targeted sample and the desire to reach all people in this group, it was not possible to have a standard control condition. Comparative data, however, were obtained from a sample of women academic chemists who attended a series of workshops held in 2006 and 2007 designed to provide training in negotiation, management, and leadership skills to help participants achieve their professional goals as faculty in the chemical sciences. Prior to attending the workshops, the women completed questionnaires that included items identical to those that were administered both pre- and postworkshop to the department heads.

While it is not possible to assess the extent to which these women are typical of all women academic chemists, or of those at only the top-rated schools, they do represent a subset of women who are concerned about issues related to gender equity within academic chemistry. Thus, if the workshops were successful in altering the attitudes and perceptions of the department heads, it would be expected that the views of the heads would be more similar to those of the women postworkshop than they were at preworkshop.

## MEASURES AND ANALYSIS

To evaluate the effectiveness of the workshop, we employ three different types of data: (a) attitudes regarding issues related to the hiring of women and women's career paths from both the department heads and the comparison group of faculty women, (b) information regarding the participants' ideas about and commitments to implementing change in their home departments and institutions expressed immediately after the workshop ended, and (c) the department heads' reports of actions they had taken to promote gender equity in the months following the conference. Including all three sources of data is important, yet rare, in this area. Taken together, the three sources of data provide a picture of changes in individuals' views of issues regarding gender equity, their commitment to change immediately postworkshop, and continuation of this commitment and taking concrete action once they returned to their academic departments and home institutions. The extent to which participants reported behaviors aimed at creating change and then actually carried out these plans are important indicators of the potential long-term efficacy of the workshop.

*Attitudes and Perceptions.* Two sets of questions tapped attitudes and perceptions regarding women's representation in academic chemistry and were asked of both the

department heads and the women in the comparison group. One set of questions asked about six factors related to hiring, specifically addressing the issues of departmental and institutional policies and procedures discussed in the workshop. These questions were phrased, e.g., as: "To what degree have the following factors limited your ability to hire women in your department in the last five years?" The issues included both those that could be seen as out of the control of a department or institution ("Too few female applicants for advertised faculty positions," and "Female candidates are in such high demand, we have lost them to other institutions"), those that were within their control or purview ("Not enough financial support from the higher levels of administration for making a competitive offer to the women candidates," and "Inability to provide employment for spouse/partner"), and those that directly involved issues of departmental climate and discrimination ("Lack of commitment of department faculty members to increase the number of women faculty," and "Some current faculty members are opposed to hiring women faculty"). Responses were given on a four-point scale ranging from "not a limitation" (1) to "serious limitation" (4).

A second set of questions asked about 11 factors that could affect women's career progress and were related to the issues of bias and prejudice discussed in the workshop. These questions were phrased, e.g., as: "In your view, how important are the following issues in slowing the career progress of women chemistry faculty at research universities relative to their male peers?" The issues included in the list range ran from those that could be seen as related to women's own behaviors and career approaches ("Women do less self-promoting and marketing of themselves than men," and "Balancing professional and family obligations,") to those that could reflect either their own actions or discrimination by their departments and the profession ("Lack of success in obtaining funding," and "Inability to compete for graduate students") to those that more clearly reflect discrimination and prejudice by departments ("Few female colleagues," "Women getting heavier teaching and/or service responsibilities," "Unwelcoming departmental climate," and "Women being excluded from important departmental and institutional decisions") or by the profession as a whole ("Women having less opportunities to be mentored by top chemists," "Gender discrimination in the peer review process of papers and grants," and "Subtle biases against women that accumulate over the years"). Responses were given on a five-point scale ranging from "not an issue" (1) to "very important" (5).

Three comparisons of scores on each item were made. The first two involve comparing the average score of department heads at pretest (before the workshop) and posttest (after the workshop) to the average scores of the women in the comparison group using independent sample $t$-tests. As noted above, if the workshop were effective, we would expect fewer significant differences between the groups with the posttest comparison than with the pretest comparison. Additionally, we examined the change in the department head scores from pretest to posttest using simple paired $t$-tests. The $t$-test is a statistic that is used to test a "null" hypothesis (hypothesis of no difference) that the average values found in two different groups are equal (the independent sample test) or that there is no difference, on average, of scores from one time to another for the people within one group (the paired $t$-test). The $t$ values are compared to standard probability tables that indicate the probability that the null hypothesis is true. Thus, if the workshop were effective, we would expect to find (a) low probability levels associated with

the *t*-values comparing the heads' pretest and posttest views and (a) higher probability values associated with comparison of women's views with those of the heads at posttest than with their views at pretest.

For all comparisons, effect size calculations were also made, using Cohen's *d* and correcting for matched samples for the prepost comparison (Cohen, 1988,1992; Dunlap, Cortina, Vaslow, & Burke, 1996). An effect size is a descriptive indicator of the strength of a difference between average values and is used as a substantive measure of effects rather than simply a probabilistic indicator. Unlike the *t*-test, the effect size is not influenced by the size of the sample that is studied. For example, for independent samples, Cohen's *d* simply equals the difference between two means divided by the common standard deviation. Thus, it is an indication of how large a difference between two means is, relative to the standard deviation. As a guideline, Cohen suggested that a *d* value of 0.2 is a small effect size, 0.5 is medium, and 0.8 is large. If the workshop were effective in promoting the department heads' understandings of barriers to women's advancement, we would expect to find both statistically and substantively significant changes in their attitudes over this time, as indicated by the *t*-tests and the *d* values, respectively.

*Commitment to Action.* While changes in attitudes and beliefs repesent an important element of change, they do not necessarily result in taking action. To examine the extent to which the workshop content inspired the department heads to commit to addressing the gender inequities in their departments, we systematically examined responses that the attendees gave to two open-ended questions asked in the evaluation form distributed anonymously at the end of the workshop: "How specifically do you see yourself using the information from the workshop to assist in advancing gender equity in your department?" and, "How specifically do you see yourself using information from the workshop to assist in advancing gender equity at your institution?" Note that these questions asked for specific responses about the attendees' own future intentions and paralleled the content of the two break-out sessions on the second day, as described above. Because the responses were gathered anonymously, they could not be linked to the attitudinal data discussed above.

All of the responses were independently coded by three of the four authors, each of whom has had extensive experience with gender equity issues in higher education. The coding process focused on two areas: the number of suggestions that were developed and the extent to which they incorporated commitment to change. Commitment to change was coded in four categories: 1 = no commitment (including blanks); 2 = mild comment, no future action indicated (e.g., learned something); 3 = some action, but no personal responsibility indicated (e.g., will discuss with others); and 4 = taking personal responsibility to initiate substantive change (e.g., will work to alter policies).[4]

*Follow-Up Activities.* While supportive attitudes and commitment are certainly necessary for change, they are not sufficient. Thus, the third assessment that we used

---

[4] Comparisons of the codes by the three raters indicated that the procedure had good reliability. The coders agreed, within a range of 1, in their codes in 98% of the cases for the counts and 95% for the ratings of commitment regarding their department, and in 100% of the cases for the counts and 98% for the ratings of commitment regarding their institution.

was based on reports attendees made on a password-protected Web site regarding the work that they had done regarding gender equity after returning to their schools. Both the quantity and the quality of these responses were examined. We looked at how quickly after the workshop the chairs reported on their actions, the number and quality of goals that they pursued, and the extent of any reported impact using techniques similar to those used in the analysis of immediate postworkshop commitments. The three coders rated the goals reported by each department chair on (a) how well the stated goals could enhance the representation of women, (b) the quality of progress reported, (c) the extent to which the goals indicated that the department culture and climate were being affected in ways that would enhance the representation of women, and (d) how fully the chairs complied with the reporting request. All ratings were on a four-point scale, with a high score indicating a strong possibility of impact, strong progress, extensive change in the commitment of all members of the department, and full compliance with the reporting request. We first examined the nature of the goals and action items and the coders' judgments of their quality.

We then combined the four scores into an additive scale (coefficient alpha = .95). Higher scores on the scale indicate that the chairs reported goals and progress that were judged more likely to result in positive changes in the status of women. For those for whom data were available, we examined the relationship of this summary scale with the heads' attitudes, changes in their attitudes over the course of the workshop, and the percentage of women in their departments. We examined these relationships to see if there were greater change efforts among those with more favorable attitudes either pre- or postworkshop, among those whose attitudes had changed more markedly, and/or among those with either more or fewer women in their departments.

## RESULTS

### Changing Attitudes and Perceptions

Table 1 summarizes the views regarding factors that have limited departments' abilities to hire women in the last five years. Mean values and standard deviations are given for department heads before attending and immediately after attending the workshop, and for the comparison group of women. Also included are the *t*-values for each of the three comparisons as well as the corresponding measures of effect size.

The department heads' responses to these questions at pretest (before the conference) indicate that attendees generally believed that the principal factors limiting their ability to hire women were largely beyond their control. For instance, well over two-fifths of the respondents indicated that having too few female applicants, losing female candidates to other departments, and not having employment for spouses or partners were at least minor limitations to their department's ability to hire women. On the other hand, only a very small minority, 13% or less, indicated that the commitment of department faculty or opposition of department faculty to hiring women was a limitation. Only about one-fourth of the respondents indicated that adequate funding was an issue in attracting women candidates. The faculty women's views were statistically significantly different from the department heads' views on all but

one of these issues. The *t*-values indicate that the faculty women were significantly less likely than the department heads to see the number of women applicants or their loss to other institutions as a problem, but more likely to cite lack of commitment and support as issues. All Cohen *d* values for these comparisons are substantial, ranging from .33 to .77.

As shown in Table 1, the attitudes of the department heads at the end of the workshop differed significantly from their attitudes before the workshop in four of the six areas examined (see the last columns in Table 1). Specifically, after attending the conference, the respondents were significantly more likely than before the conference to report that their department faculty members were not committed to hiring women, that some were actually opposed to doing so, that they didn't have enough financing, and that they did not have enough employment for spouses or partners. For each of these areas, the views of the heads were no longer statistically different from those of the women faculty and the values of Cohen's *d* were much smaller. Notably, all of these areas are ones over which a department head could have some type of influence or control. In general, the workshop seemed to result in substantial changes in the heads' views of the barriers to their department's ability to hire women.

Table 2 summarizes the department heads' perceptions of factors that slow the progress of women chemistry faculty at research institutions generally. As with their views of limits on hiring, the respondents' views of barriers before attending the conference tended to emphasize issues that could be seen as being beyond their administrative control. The only barrier that was seen as moderately or very important by a majority of the attendees was the issue of balancing career and family life (cited by 87% of the respondents). At the same time, over half of the attendees believed that heavier teaching loads, few available mentors, and discrimination in the peer review process were either "not an issue" or "not important." More than three-fourths of the department heads believed that women's lack of success in funding and their inability to get the best graduate students were "not important" or "not an issue."

The views of the women faculty in the comparison group were significantly different from those of the department heads in nine of the eleven questions – all but the role of balancing family and professional obligations and having few female colleagues. For all of the factors, women saw the issues as more important than the department heads. The effect sizes associated with these significant differences were all large, ranging from .76 to 1.22.

The responses of the department heads to these questions after attending the conference indicated substantially greater awareness of barriers that women face in academic chemistry. Of the 11 factors studied, there were statistically significant changes in all items except those regarding too few female colleagues and difficulties in balancing career and family. Notably, these two items could be seen as those that involve characteristics of women themselves (e.g., not being able to work well without women colleagues or unable to balance personal and family lives), rather than characteristics of the department or institution, and were also those for which the heads' views did not differ from the women's at pretest. In all cases, the changes were as expected, with conference attendees becoming more aware of limitations to hiring women and barriers that face women in their careers. For instance, the proportion indicating that heavier work loads and an unwelcoming department climate were at least moderately important barriers

**Table 1.** Perceived Factors Limiting Ability to Hire Women in the Last Five Years, Faculty Women and Heads Preworkshop and Postworkshop

| To what degree have the following factors limited your department's ability to hire women in the last five years? (4 = serious limitation, 1 = not a limitation) | Group | Mean | SD | Pretest Heads versus Faculty Women | | Posttest Heads versus Faculty Women | | Pretest Heads versus Posttest Heads | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | t | Cohen's d | t | Cohen's d | t | Cohen's d |
| 1. Too few female applicants for advertised faculty positions | Faculty Women | 2.72 | 1.06 | −3.53*** | −0.66 | −2.23* | −0.43 | 1.56 | 0.26 |
| | Heads, Pretest | 3.31 | 0.71 | | | | | | |
| | Heads, Posttest | 3.11 | 0.78 | | | | | | |
| 2. Female candidates are in such high demand, we have lost them to other institutions | Faculty Women | 2.27 | 1.09 | −2.84** | −0.57 | −4.19*** | −0.82 | −1.64 | −0.19 |
| | Heads, Pretest | 2.89 | 1.09 | | | | | | |
| | Heads, Posttest | 3.08 | 0.91 | | | | | | |
| 3. Lack of commitment of department faculty members to increase the number of women faculty | Faculty Women | 2.00 | 1.11 | 2.36* | 0.46 | 0.27 | 0.06 | −2.42* | −0.41 |
| | Heads, Pretest | 1.56 | 0.82 | | | | | | |
| | Heads, Posttest | 1.94 | 1.01 | | | | | | |

neering

Volume 14, Issue 1

Gender Equity in Academic Departments

pnd

Heads, Posttest 1.94 1.01

**Table 1.** Perceived Factors Limiting Ability to Hire Women in the Last Five Years, Faculty Women and Heads Preworkshop and Postworkshop   (continued)

| | | | | | Pretest Heads versus Faculty Women | | Posttest Heads versus Faculty Women | | Pretest Heads versus Posttest Heads | |
|---|---|---|---|---|---|---|---|---|---|---|
| 4. | Some current faculty members are opposed to hiring women faculty | Faculty Women | 1.57 | 0.97 | 2.93** | 0.55 | 1.55 | 0.29 | −2.22* | −0.32 |
| | | Heads, Pretest | 1.14 | 0.59 | | | | | | |
| | | Heads, Posttest | 1.33 | 0.63 | | | | | | |
| 5. | Not enough financial support from the higher levels of administration for making a competitive offer to the women candidates | Faculty Women | 2.17 | 1.23 | 4.09*** | 0.77 | 1.57 | 0.30 | −3.63*** | −0.48 |
| | | Heads, Pretest | 1.39 | 0.80 | | | | | | |
| | | Heads, Posttest | 1.83 | 1.00 | | | | | | |
| 6. | Inability to provide employment for spouse or partner | Faculty Women | 3.04 | 1.10 | 1.62 | 0.33 | −0.25 | 0.05 | −2.50* | −0.43 |
| | | Heads, Pretest | 2.69 | 0.95 | | | | | | |
| | | Heads, Posttest | 3.08 | 0.84 | | | | | | |

Note: Only responses from the department heads who answered the questions at both pretest and posttest are included in the analysis (N = 36, except for item 3, where n = 34). For the women faculty, the number of responses ranges from 79 to 82. Independent t-test values are reported for the comparisons of the heads and women. Paired t-test values are reported for the pretest-posttest comparisons.
* = $p < .05$, ** = $p < .01$, *** = $p < .001$

**Table 2.** Perceived Factors that Slow Progress of Women Faculty, Preworkshop and Postworkshop, Faculty Women and Heads Pre- and Postworkshop

| | How important are these factors in slowing the progress of women? (1 = not an issue, 5 = very important) | | Mean | SD | Pretest Heads versus Faculty Women | | Posttest Heads versus Faculty Women | | Pretest Heads versus Posttest Heads | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | t | Cohen's d | t | Cohen's d | t | Cohen's d |
| 1. | Women do less self-promoting and marketing of themselves than men | Faculty Women | 4.30 | 0.95 | 5.66*** | 1.23 | 5.1 *** | 1.01 | −2.02* | −0.30 |
| | | Heads, Pretest | 2.91 | 1.31 | | | | | | |
| | | Heads, Posttest | 3.29 | 1.07 | | | | | | |
| 2. | Balancing professional and family obligations | Faculty Women | 4.54 | 0.85 | 0.23 | 0.05 | 0.75 | 0.16 | 0.90 | 0.12 |
| | | Heads, Pretest | 4.50 | 0.70 | | | | | | |
| | | Heads, Posttest | 4.42 | 0.69 | | | | | | |
| 3. | Women's lack of success in obtaining funding | Faculty Women | 3.53 | 1.21 | 7.67*** | 1.48 | 3.91*** | 0.81 | −3.42** | −0.64 |
| | | Heads, Pretest | 1.97 | 0.89 | | | | | | |
| | | Heads, Posttest | 2.60 | 1.06 | | | | | | |
| 4. | Women's inability to compete for the best graduate students | Faculty Women | 3.19 | 1.37 | 5.73*** | 1.10 | 2.53** | 0.49 | −4.08*** | −0.69 |
| | | Heads, Pretest | 1.91 | 0.95 | | | | | | |
| | | Heads, Posttest | 2.60 | 1.03 | | | | | | |
| 5. | Few female colleagues | Faculty Women | 3.89 | 0.99 | 0.32 | 0.07 | −0.13 | −0.03 | −0.62 | −0.11 |
| | | Heads, Pretest | 3.83 | 0.86 | | | | | | |
| | | Heads, Posttest | 3.91 | 0.74 | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Heads, Pretest | 3.83 | 0.86 | | | | | |
| Heads, Posttest | 3.91 | 0.74 | | | | | |

**Table 2.** Perceived Factors that Slow Progress of Women Faculty, Preworkshop and Postworkshop, Faculty Women and Heads Pre- and Postworkshop   (continued)

| # | Factor | Group | Mean | SD | Pretest Heads versus Faculty Women | | Posttest Heads versus Faculty Women | | Pretest Heads versus Posttest Heads | |
|---|---|---|---|---|---|---|---|---|---|---|
| 6. | Women getting heavier teaching and/or service responsibilities relative to their male colleagues | Faculty Women | 3.55 | 1.19 | 5.62*** | 1.12 | 2.92** | 0.59 | −3.29** | −0.57 |
| | | Heads, Pretest | 2.17 | 1.27 | | | | | | |
| | | Heads, Posttest | 2.86 | 1.14 | | | | | | |
| 7. | Unwelcoming departmental climate for women | Faculty Women | 3.90 | 1.27 | 4.94*** | 1.00 | 3.15** | 0.65 | −3.13** | −0.39 |
| | | Heads, Pretest | 2.63 | 1.29 | | | | | | |
| | | Heads, Posttest | 3.11 | 1.16 | | | | | | |
| 8. | Women being excluded from important departmental and institutional decisions | Faculty Women | 3.41 | 1.54 | 6.41*** | 1.22 | 2.54** | 0.54 | −3.45** | −0.67 |
| | | Heads, Pretest | 1.85 | 1.02 | | | | | | |
| | | Heads, Posttest | 2.65 | 1.32 | | | | | | |
| 9. | Women having less opportunities to be mentored by top chemists | Faculty Women | 3.94 | 1.10 | 5.94*** | 1.22 | 3.03** | 0.61 | −4.59*** | −0.66 |
| | | Heads, Pretest | 2.50 | 1.25 | | | | | | |
| | | Heads, Posttest | 3.28 | 1.06 | | | | | | |

**Table 2.** Perceived Factors that Slow Progress of Women Faculty, Preworkshop and Postworkshop, Faculty Women and Heads Pre- and Postworkshop  (continued)

| | | | | Pretest Heads versus Faculty Women | | Posttest Heads versus Faculty Women | | Pretest Heads versus Posttest Heads | |
|---|---|---|---|---|---|---|---|---|---|
| 10. | Gender discrimination in the peer review process of their papers and grants | Faculty Women | 3.38 | 1.39 | 4.09*** | 0.87 | 2.27* | 0.44 | -2.90** | -0.54 |
| | | Heads, Pretest | 2.26 | 1.16 | | | | | | |
| | | Heads, Posttest | 2.85 | 0.99 | | | | | | |
| 11. | Subtle biases against women faculty that accumulate over the years | Faculty Women | 4.10 | 1.09 | 3.84*** | 0.76 | 0.93 | 0.19 | -3.42** | -0.55 |
| | | Heads, Pretest | 3.23 | 1.19 | | | | | | |
| | | Heads, Posttest | 3.89 | 1.21 | | | | | | |

Note: $N$ ranges from 80 to 82 for faculty women, 34 to 36 for department heads.
* = $p < .05$, ** = $p < .01$, *** = $p < .001$.

for women's advancement went from only about a fifth to one-third. The recognition of subtle biases against women as a barrier that is at least moderately important rose from less than a half to close to two-thirds of the attendees.

As expected, the views of department heads at posttest were closer to those of the women faculty. However, even though the department heads' views of barriers that face women changed significantly from pretest to posttest, they continued to differ from the women faculty. Although the effect sizes describing the differences between the women faculty and the department heads at posttest are substantially smaller than the comparisons with pretest, the heads at posttest are still less likely than the faculty women to rate many of the factors studied as important in slowing women's career progress.

## COMMITMENT TO ACTION

Table 3 summarizes the responses that the department heads made, immediately following the workshop, regarding how they would use information from the workshop to advance gender equity in both their department and their institution. The top panel of Table 3 summarizes responses regarding change in their departments. On average, the heads listed 1.4 items that they would pursue, with a range from none to four (SD = 1.1). Slightly less than one-fourth (11 out of 50) left the question blank and two gave a mild, but supportive, comment such as, "Some suggestions are quite valuable." Eight respondents gave responses that indicated some action, but little personal responsibil-

---

**Table 3.** Responses to Follow-Up Questions Regarding Commitment to Advancing Gender Equity in Department and Home Institution

---

**"How specifically do you see yourself using the information from the workshop to assist in advancing gender equity in your department?"**

| | N |
|---|---|
| 1. No answer or noncommittal response such as "not clear at this point" | 11 |
| 2. Mild, but supportive responses, such as "frequently, very useful" or "some suggestions…are quite valuable" | 2 |
| 3. Some action, but not a high degree of personal responsibility | 8 |
| 4. Taking personal responsibility to initiate change | <u>29</u> |
| Total | 50 |

---

**"How specifically do you see yourself using the information from the workshop to assist in advancing gender equity at your institution?"**

| | N |
|---|---|
| 1. No answer or noncommittal response such as "not clear at this point" | 20 |
| 2. Mild, but supportive responses | 2 |
| 3. Some action, but not a high degree of personal responsibility | 4 |
| 4. Taking personal responsibility to initiate change | <u>24</u> |
| Total | 50 |

---

ity. Examples of responses in this category are (a) "We have been pushing for diversity advocacy in our department.... The recommendations of this workshop will help;" (b) "Taking information back to colleagues at home and open discussions of gender equity;" and (c) "Educate my faculty." Over half of the group ($n = 29$) gave responses that indicated they would take personal responsibility to institute and guide change, including actions such as setting departmental goals regarding equity and altering training and procedures. Examples of responses in this group include (a) "Revise mentoring; new diversity training at faculty retreat;" (b) "I will immediately try to get information on schemas discussed/presented at a faculty meeting/grad student meeting; I will see if an antidiscrimination workshop can be placed online; I will try to engage more women graduate students;" and (c) "Setting long-term goals for the department to hire women; changing recruitment practices; starting departmental support groups and workshops for women; adding departmental seminars/workshops for gender equity."

The second panel of Table 3 summarizes responses regarding efforts to promote change at their institution. There were somewhat fewer commitments to institutional change than to departmental change, with 20 respondents giving no answer or a non-committal response. As with the first question, the range of number of responses was from none to four. (The average number of commitments listed was .81, SD = .8.) Two respondents gave answers that were rated as "mild, but supportive," with comments such as (a) "I would like to see more cross-campus efforts to address gender/racial equity" and (b) "Some suggestions concerning graduate student and postdoc support are quite valuable." Four others had comments rated as implying some action, but not a high degree of personal responsibility. Examples of these comments are (a) "Certain key recommendations can be relayed to relevant parts of my institution for implementation....," and (b) [I will] "ask institutional diversity office for support and encourage the office to review and unify its efforts." Of the 30 respondents who indicated at least one area that they would pursue, 24 had suggestions that were ranked, by the coders, as indicating a high level of individual commitment to change. Examples include(a) "Bring ideas and materials to administrative attention;" (b) "I plan to talk to administrators about the importance of resources in this endeavor;" (c) "Start by talking to other science chairs and the dean;" (d) "Consortium with all regional schools to provide options for spousal hiring;" and (e) "Get child-care and start-up packages; revise tenure procedures."

The department heads that made more extensive commitments to change in their departments tended also to be those who made more extensive commitments to change in their institutions and vice versa. For instance, 20 of the 50 department heads indicated very high personal commitment to change in both their departments and institutions, and eight gave no response at all to either of the queries.

## FOLLOWING THROUGH

By December, 2006, almost one year after the workshop was held, 45 of the 56 eligible department chairs posted a report of action items and goals that they were pursuing. The pace at which the chairs reported their actions varied considerably, and many submitted their reports only after receiving repeated encouragement to do so. By the end of August, 2006, six months after the workshop, representatives of only six schools had re-

sponded. At that time e-mail reminders were sent to all chairs urging them to respond, and an additional 11 did so by the end of October. After that time, representatives of the funding agency and members of the steering committee individually contacted chairs, encouraging them to report their progress, resulting in the remaining 28 responses. Over half of the chairs ($n = 31$) reported action items, associated goals, and progress that they were making toward accomplishing those goals. Twelve more chairs reported both action items and associated goals, but omitted a report of progress.

The responding chairs listed from one to eight action items that they would address. Action items were chosen from a list developed and agreed on at the workshop. Table 4 lists the action items that the chairs agreed to, examples of specific goals that were mentioned, and the number of people listing each item. The three most frequently chosen action areas, each chosen by over 20 department chairs, all involved issues of recruitment and support of women faculty. The most frequently mentioned area was establishing effective mechanisms for assisting the career development of young faculty, followed closely by doubling the representation of women in the applicant pool and assuring that mid- and senior-level faculty, especially women, were participating in leadership roles. Items less frequently chosen were those that involved institutional reform or educational efforts within the department, such as policies regarding spousal hiring or child care, alterations in scheduling and planning, and educational programs.

Table 5 reports the raters' judgments of the quality of the stated goals on three dimensions: (a) how well the goals could enhance the representation of women, (b) the quality of progress reported, and (c) the extent to which the goals indicated that the department culture and climate were being affected in ways that would enhance the representation of women. As noted earlier, the rankings were on a four-point scale, with higher scores indicating a greater potential to improve the status of women.

The rankings of the first and third dimensions were highly correlated (Spearman's $\rho$, a rank-order correlation, = .83). The three sets of goals rated most likely to enhance the representation of women were also the three rated most likely to improve the department culture and climate: establishing effective mechanisms for assisting the career development of young faculty, educating all faculty members and students regarding the accumulation of disadvantage to women, and assuring that mid- and senior-level faculty women participate in leadership roles. Similarly, the three sets of goals rated least likely to enhance women's representation or alter the departmental climate were identical: increasing women's representation in the applicant pool, making diversity an academic priority and developing programs to enhance recruitment and retention of all faculty, and advocating for institutional child care. Thus, the raters agreed that the goals that would have the greatest impact on women's representation would also have the greatest impact on departmental culture and climate.

At the same time, however, the coders were much more likely to believe that the stated goals would enhance women's representation through the efforts of the department chair than that they would alter departmental culture or climate in ways that would benefit women. The average quality rating assigned on the first dimension was 2.7, where a score of 3 indicated changes that involved a moderate level of potential impact on women's representation. In contrast, the average rating on the third dimension, regarding departmental culture, was only 2.0, indicating that, on average, the changes primarily involved only the actions and commitment of the department chair. In addi-

**Table 4.** Action Items, Sample Goals, and Number of Department Chairs Endorsing Each Action Item

| Action Item | Examples of Stated Goals | Number of Heads Endorsing |
|---|---|---|
| 1. Double the percentage of women applicants in the applicant pool in the next year (AY 05–06 versus AY 06–07). | Broaden the search area | 22 |
| | Use faculty as "talent scouts" at meetings and seminars | |
| 2. Establish effective mechanisms for assisting career development of young faculty, especially women. | Establish a mentoring program consisting of recently tenured faculty and schedule regular meetings with junior faculty | 26 |
| | Nominate women for awards and fellowships | |
| | Increase the visibility within the scientific community by providing opportunities for research presentations, external seminars, etc. | |
| | Ensure transparency in department policies and decision-making policies | |
| 3. Consider personal obligations in academic scheduling and planning. | Organize teaching schedules with family obligations in mind | 10 |
| | Revise, where necessary, faculty evaluation processes so as to take into account the impact of legitimate personal obligations and to provide resources for re-entry strategies | |
| | Schedule meetings and other activities at times that maximize attendance | |
| 4. Develop and implement programs that educate all faculty members and students in your department regarding the accumulation of disadvantages of women. | Organize and support workshops that educate on issues of gender bias and decision-making, gender schemas, accumulation of disadvantage, professional versus nonprofessional behavior, etc. | 10 |
| | Build community and listen to colleagues regarding important issues | |

**Table 4.** Action Items, Sample Goals, and Number of Department Chairs Endorsing Each Action Item (continued)

| Action Item | Examples of Stated Goals | Number of Heads Endorsing |
|---|---|---|
| 5. Make diversity an academic priority and develop programs that enhance recruitment and retention of faculty. | Revise promotion and appointment processes | 13 |
| | Establish term limits on leadership positions, e.g., dept. chairs/heads | |
| | Develop a department committee on women in chemistry | |
| 6. Develop policies within your institution to facilitate the hiring of women, including facilitating spousal hiring. | Create policies that will provide employment for spouses | 15 |
| | Term-limited endowed chairs | |
| | Construct a database of jobs available in local area | |
| 7. Assure that mid- and senior-level faculty, especially women, are participating in leadership roles. | Key participation in research centers | 21 |
| | Involve women in key decision making regarding academic priorities | |
| | Involve women in key decision making regarding financial priorities | |
| 8. Recognize the importance of and advocate for institutional support of child care. | Advocate for new child-care facilities on campus | 8 |
| | Institutionalize and fund policies for family leave for graduate students and postdoctoral fellows | |

tion, ratings of the quality of progress toward the goals indicated a judgment that they were, on average, only slightly beyond the beginning stages of progress (mean = 2.2).

Comparing the results in Tables 4 and 5, it may be seen that the action items and goals that were most frequently pursued included both those rated as providing high and low potential of change. Both one of the most frequently chosen action items (increasing the leadership role of mid- and senior-level women) and one of the least frequently chosen items (efforts to educate faculty and students) were rated as having the most possible impact. Goals related to doubling the representation of women in the applicant pool, also one of the most frequently chosen, were rated the lowest in terms of potential impact.

Finally, we examined the relationship of the summative measure of the quality of

**Table 5.** Average Ratings by Coders of the Quality of Goals and Progress by Action Item

| Action Item | Quality Goals | Quality Progress | Dept. Climate |
|---|---|---|---|
| 1. Increasing women in pool, doubling percent | 2.5 | 2.0 | 1.9 |
| 2. Career development of young faculty | 2.9 | 2.1 | 2.3 |
| 3. Consider personal obligations in planning | 2.8 | 2.6 | 2.2 |
| 4. Develop educational programs | 2.9 | 2.1 | 2.3 |
| 5. Make diversity a priority | 2.6 | 2.2 | 2.0 |
| 6. Institutional policies and spousal hiring | 2.7 | 2.2 | 1.8 |
| 7. Increase leadership of senior women | 2.9 | 2.3 | 2.4 |
| 8. Advocate for institutional childcare support | 2.6 | 2.0 | 1.4 |

*Notes:* All ratings were on a four-point scale, with a high score indicating, respectively, a strong possibility the goals would impact the representation of women, strong progress toward meeting the goal, and that the goals would result in strong changes in the commitment of the entire department. See discussion in the text and footnote 5 for details.

the goals, progress, and action items reported by each chair to their attitudes, using the variables described above. There were no significant associations between the summary measure of the rated quality of their action items and progress and their attitudes either pre- or postworkshop, or changes in attitudes during the workshop. There was also no relationship between the percentage of women in a department and the ratings of quality, but there was a significant association between the extent to which chairs fully complied with the reporting requests and the representation of women in the department. Chairs of departments where women were less well represented (where women comprised, on average, 16.4% of the total faculty) were more likely to report action items, goals, and progress than those where women comprised somewhat more of the faculty (20.3% on average) ($t$ = 2.13, degrees of freedom = 33, $p$ = .04).

## SUMMARY AND DISCUSSION

Our results indicate that a carefully planned intervention can result in significant changes in department chairs' attitudes regarding both limitations to achieving gender equity and barriers that face individual women in their academic careers. In addition, the intervention appears to have promoted individual commitment to change, both immediately after the workshop and, more importantly, continuing for several months after the workshop's end. The quality and extent of actions reported were not related to the extent to which participants' attitudes changed. Yet, those who reported the most extensive activity were chairs of departments with fewer women, perhaps indicating a greater sense of urgency to alter their situation.

Of course, not all chemistry department chairs changed attitudes or reported commitment to change or actually taking action. In addition, their attitudes still were not equivalent to those of women faculty, even at the end of the workshop. Even though

the department heads became more aware of barriers to women's careers, they did not perceive the situation as negatively as did a group of women faculty members. In addition, the actions that they reported taking were judged to have, on average, only a moderate level of potential impact on women's status, and even less potential impact on the gender-related climate of the entire department.

Nevertheless, the fact that the vast majority of the chairs did report commitments and actions seems noteworthy, especially given the oft-noted independent orientation of the professoriate. We suggest that there are three general factors that might help explain the success of this endeavor. These factors reflect the background literature discussed above. They involve the principles of the contact hypothesis and the notion that positive intergroup relations result from situations with mutual cooperation toward common goals. They also embody lessons from the knowledge of effective change programs, building on practices that are most likely to promote sensitivity and avoid backlash.

First, the issue of women's underrepresentation in academic chemistry can be well identified and recognized. Extensive data point to the fact that new women doctorates in chemistry more often opt to work in nonacademic sectors than in the academic world. The disproportionate underrepresentation of women in academic chemistry is well known, and there seems to be wide agreement that women's underrepresentation could be solved without altering the potential pool of applicants. In other words, the problem can easily be recognized as real and as one that can be potentially addressed without changes that would involve the graduate pipeline and supply.

Second, the targets of the intervention, chairs of academic chemistry departments, may have been especially susceptible to efforts to alter attitudes and behaviors. Given the characteristics of the pool of chemistry graduate students and the nature of graduate training, virtually all heads would have been exposed to women students and potentially worked with lab groups with a substantial proportion of women. Thus, they have had firsthand knowledge of the availability of women chemists who could be excellent faculty members. Also, as noted above, the department heads, like others within academia, might well have characteristics cited by the literature as reducing prejudice and enhancing the acceptance of egalitarian ideology. These personal characteristics could have enhanced their receptiveness to issues discussed in the workshop and their ability to embrace and advocate for change.

Third, characteristics of the intervention itself may have prompted change. The intervention embodied respect for the participants coupled with support for change from those with access to resources that were important to the participants and their departments. The workshop was purposely limited to representatives of the most prestigious schools, invitations came from respected colleagues, and all attendees were well known to each other. The involvement of the funding agencies was clear and consistent prior to, during, and after the workshop, indicating their strong concern about women's representation and their support for change. The manner in which the workshop was held avoided aspects shown in the literature to promote backlash, and instead involved an atmosphere of mutual problem solving.

Future research will be important in order to see the extent to which the success of these endeavors can be extended to other fields. As noted above, academic areas besides chemistry in which women are disproportionately absent from the academic ranks include both medicine and economics. Like chemistry, both of these fields also have ex-

tensive nonacademic employment opportunities. Decision makers in these fields would be expected to have the characteristics of chemistry department chairs that we have suggested could promote openness to promoting gender equity. The nature of graduate training in these fields, however, differs some from chemistry. It could be suggested that the collective enterprise that is often associated with laboratory situations in chemistry promotes the respect and familiarity that the contact hypothesis suggests is crucial to developing harmonious intergroup relations. In contrast, graduate students in economics most often develop individual relations with faculty mentors as teachers or advisors. Future research could explore the extent to which alternative forms of graduate training and interaction affect readiness to promote gender equity.

A second area associated with this project that should be studied more thoroughly is the role of the external funding agencies. Federal agencies provided the funds for the workshop and were actively involved in recruiting participants and in encouraging them to report on their progress after the workshop. Top-ranked chemistry departments are very dependent on these federal agencies for grant support, and this financial dependence likely influenced the heads' receptiveness to the messages that were given and their willingness to follow up with later actions. Other fields and other chemistry departments may not be as dependent on such funding, and heads from these areas may not have responded in the same way. In addition, it is no doubt unrealistic to expect an equivalent level of funding if the workshop were to be replicated in other settings. Thus, it would be important to see the extent to which the workshop could produce similar results without the funding that was provided here and without the overt support and encouragement of funding agencies.

Finally, it is important to engage in long-term follow-ups of the heads and their departments. Our results indicate that many of the department heads' attitudes changed during their attendance at the workshop, that they expressed commitment to actions at the end of the workshop, and that many of them had begun concrete actions to promote gender equity several months after the end of the project. It will be important to monitor these efforts in the future to see the extent to which they continue and, more importantly, to see the extent to which they actually result in greater representation of women in academic chemistry and department climates that are supportive of their presence. While the actions, goals, and progress reported in the months following the workshop primarily involved activities of either the department chairs or small groups of faculty, it may be possible that these actions represent the beginning stages of more extensive change. On the other hand, since many of the actions were rated as having, at best, only a moderate level of potential impact, it is possible that change efforts could easily lag. Only additional research can determine which outcome actually occurs.

## REFERENCES

Allport, G. (1954). The nature of prejudice. Reading, MA: Addison-Wesley.
Astin, H. S. (1969). The woman doctorate in America: Origins, career, and family. New York: Russell Sage.
Bickel, J., Wara, D., Atkinson, B. F., Cohen, L. S, Dunn, M., Hostler, S., Johnson, T. R. B.,

Mo
en's
con
Bielby,
ma
mu
Blalock,
Blalock
tive
Bronste
ter
39,
Cohen,
dal
Cohen,
Cotton,
Im
Re
Dunlar
me
1, 1
Etzkow
wo
Fox, M
Zu
cor
Fox, M
sor
Th
Golde,
tio
Hart, 1
Sti
Hill, N
Sh
of
Kalev,
fic
Re
Kuck,
th
ch
Long,
do
Mabbi
Id

Morahan, P., Rubenstein, A. H., Sheldon, G .F, & Stokes, E. (2002). Increasing women's leadership in academic medicine: Report of the AAMC project implementation committee. Academic Medicine, 77 (10), 1043-1061.

Bielby, W. T. (1991). Sex differences in careers: Is science a special case? In: H. Zuckerman, J. R. Cole, & J. T. Bruer (Eds.), The outer circle: Women in the scientific community (pp. 171-187). New York: W.W. Norton.

Blalock, H. M. (1967). Toward a theory of minority group relations. Hoboken, NJ: Wiley.

Blalock, H. M., & Wilken, P. H. (1979). Intergroup processes: A micro-macro perspective. New York: Free Press.

Bronstein, P., & Farnsworth, L. (1998). Gender differences in faculty experiences of interpersonal climate and processes for advancement. Research in Higher Education, 39, 557-585.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Erlbaum.

Cohen, J. (1992). A power primer. Psychological Bulletin, 112, 155-159.

Cotton, K. (1993). Fostering intercultural harmony in schools: Research finding. School Improvement Research Series, Topical synthesis #7, Portland, Oregon: Northwest Regional Educational Laboratory.

Dunlap, W. P., Cortina, J. M., Vaslow, J. B.,& Burke, M. J. (1996). Meta-analysis of experiments with matched groups or repeated measures designs. Psychological Methods, 1, 170-177.

Etzkowitz, H., Kemelgor, C., & Uzzi, B. (2000). Athena unbound: The advancement of women in science and technology. New York: Cambridge University Press.

Fox, M. F. (1991). Gender, environmental milieu, and productivity in science. In: H. Zuckerman, J. R. Cole, & J. T. Bruer, (Eds.), The outer circle: Women in the scientific community (pp. 188-204). New York: W.W. Norton.

Fox, M. F. (1995). Women and scientific careers. In: S. Jasanoff, G. E. Markle, J. C. Peterson, & T. Pinch, (Eds.), Handbook of science and technology studies (pp. 205-223). Thousand Oaks, CA: Sage.

Golde, C. M. (2005). The role of the department and discipline in doctoral student attrition: Lessons from four departments. Journal of Higher Education, 76, 669-700.

Hart, T. E., & Lumsden, L. Confronting Racism in the Schools. Eugene: Oregon School Study Council, May 1989. OSSC Bulletin Series. 33 pages. ED 306 705.

Hill, M. E., & Augoustinos, M.. (2001). Stereotype change and prejudice reduction: Short- and long-term evaluation of a cross-cultural awareness programme. Journal of Community and Applied Social Psychology, 11, 243-262.

Kalev, A., Dobbin, F., & Kelly, E. (2006). Best practices or best guesses? Assessing the efficacy of corporate affirmative action and diversity policies. American Sociological Review, 71, 589-617.

Kuck, V. J., Marzabadi, C. H., Nolan, S. A., & Buckner, J. P. (2004). Analysis by gender of the doctoral and postdoctoral institutions of faculty members at the top-fifty ranked chemistry departments. Journal of Chemical Education, 81, 356-363.

Long, J. S. (Ed.) (2001). From scarcity to visibility: Gender differences in the careers of doctoral scientists and engineers. Washington, DC: National Academy Press.

Mabbutt, R. (1991). Reducing Bias: Research Notes on Racism in America. Boise, ID: Idaho Human Rights Commission.

Marasco, C. A. (2006). Women faculty gain little ground. Chemical and Engineering News, 84(51), 58–59.

McMillen, D. P., & Singell, L. D., Jr. (2001). Gender differences in first jobs for economists. Southern Economic Journal, 60, 701–714.

Miller, N., & Brewer, M. B. (Eds.) (1984). Groups in contact: The psychology of desegregation. Orlando: Academic Press.

Morrissey, S. R. (2006). Gender equity. Chemical and Engineering News, 84, 65–69.

Moskos, C. C., & Butler, J. S. (1996). All that we can be: Black leadership and racial integration the army way. New York: Basic Books.

Muthuswamy, N., Levine, T. R., & Gazel, J. (2006). Interaction-based diversity initiative outcomes: An evaluation of an initiative aimed at bridging the racial divide on a college campus. Communication Education, 55, 105–121.

Naff, K. C., & Kellough, J. E. (2003). Ensuring employment equity: Are federal diversity programs making a difference? International Journal of Public Administration, 26, 1307–1336.

National Center for Education Statistics. (2005). Digest of Education Statistics, 2005. Retrieved August 10, 2006 from NCES at http://nces.ed.gov/programs/digest/d05_tf.asp.

Nelson, D. J. (2005). A national analysis of diversity in science and engineering faculties at research universities. Retrieved February 27, 2007, from Diversity in Science Association at http://cheminfo.ou.edu/~djn/diversity/briefings/Diversity%20Report%20Final.pdf.

Pate, G. S. (1981). Research on prejudice reduction. Educational Leadership, 38, 288–291.

Pate, G. S. (1988). Research on reducing prejudice. Social Education, 52, 287–289.

Rossi, A. (1965). Women in science: Why so few? Science, 148, 1196–1203.

Rynes, S., & Rosen, B. (1995). A field study of factors affecting the adoption and perceived success of diversity fraining. Personnel Psychology, 48, 247–270.

Sears, A. L. W. (2003). Image problems deplete the number of women in academic applicant pools. Journal of Women and Minorities in Science and Engineering, 9, 169–181.

Settles, I. H., Cortina, L. M., Malley, J., & Stewart, A. J. (2006). The climate for women in academic science: The good, the bad, and the changeable. Psychology of Women Quarterly, 30, 47–58.

Singell, L. D., & Stone, J. A.. (1993). Gender differences in Ph.D. economists' careers. Contemporary Economic Policy, 11, 95–106.

Springer, L., Palmer, B., Terenzini, P. T., Pascarella, E. T., & Nora, A. (1996). Attitudes toward campus diversity: Participation in a racial or cultural awareness workshop. Review of Higher Education, 20, 53–68.

Stewart, A. J., LaVaque-Mantry, D., & Malley, J. E.. (2004). Recruiting female faculty members in science and engineering: Preliminary evaluation of one intervention model. Journal of Women and Minorities in Science and Engineering, 10, 361–375.

Stockard. J. (1999). Gender socialization. In: J. S. Chafetz (Ed.), Handbook of Gender Sociology (pp. 215–228). New York: Plenum.

Stockard, J., & Johnson, M. M. (1992). Sex and gender in society. Englewood Cliffs, NJ: Prentice Hall.

Stockard, J., Schmuck, P. A., Kempner, K., Williams, P., Edson, S., & Smith, M. A. (1980). Sex Equity in Education. New York: Academic Press.

Valian, V. (1999). Why so slow? The advancement of women. Cambridge, Mass: MIT Press.

Valian, V. (2005). Beyond gender schemas: Improving the advancement of women in academia. Hyperia, 20, 198–213.

Van Anders, S. M. (2004). Why the academic pipeline leaks: Fewer men than women perceive barriers to becoming professors. Sex Roles, 51, 511–521.

Walsh, D. (1988). Critical thinking to reduce prejudice. Social Education, 52, 280–282.

Xie, Y., & Shauman, K. A.. (2003). Women in science: Career processes and outcomes. Cambridge, MA: Harvard University Press.

Zuckerman, H. (1991). The careers of men and women scientists: A review of current research. in Zuckerman, H., Cole, J. R., & Bruer, J. T. (Eds.).The outer circle: Women in the scientific community (pp. 27–56). New York: W.W. Norton.