GENDER EQUITY IN MATERIALS SCIENCE AND ENGINEERING

A Report on the

Workshop on Gender Equity in Materials Science and Engineering

May 18 - 20, 2008

College Park, Maryland

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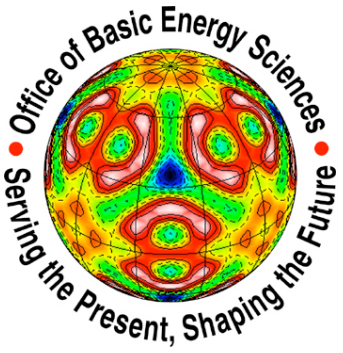

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Table of Contents

Summary 1

Recommendations: 2

Recommended Follow Up 3

Overview 4

The University Materials Council 5

Gender Equity in STEM Fields 6

Gender Equity in MSE 9

Understanding Implicit Biases 11

Balancing work and family life 14

Comparative Environments 18

Discussions 19

Breakout Groups 21

Survey Results 24

Appendix I: Program 25

Appendix II: Breakout Questions 29

Appendix III: Participants 31

References 33

Summary

At the request of the University Materials Council, a national workshop was convened to examine "Gender Equity Issues in Materials Science and Engineering." The workshop considered causes of the historic underrepresentation of women in materials science and engineering (MSE), with a goal of developing strategies to increase the gender diversity of the discipline in universities and national laboratories. Specific workshop objectives were to examine efforts to level the playing field, understand implicit biases, develop methods to minimize bias in all aspects of training and employment, and create the means to implement a broadly inclusive, family-friendly work environment in MSE departments.

Held May 18–20, 2008, at the Conference Center at the University of Maryland, the workshop included heads and chairs of university MSE departments and representatives of the National Science Foundation (NSF), the Office of Basic Energy Sciences of the Department of Energy (DOE-BES), and the national laboratories. There were 98 registered participants, including 62 attendees representing 45 different universities and 11 attendees representing 9 national laboratories. A variety of other voices were represented as well, including women in MSE at an early stage of their careers, invited speakers, and representatives of MSE technical societies.

The general trends for inclusion of women in engineering hold as well for MSE. The fraction of women in MSE student populations and on faculties has increased over the past 23 years, but the percentage of women decreases at every career transition. While women now receive more than 50 percent of doctorates in the life sciences and 30 percent in chemistry, they receive fewer than 28 percent of doctoral degrees in MSE. The representation of women in the MSE professoriate averages 12 percent, but remains in single digits at the majority of institutions.

Materials science and engineering graduate schools draw from a broad population, including chemists, physicists, and electrical and mechanical engineers, for faculty positions. Therefore, it appears that a higher proportion of women on the faculties/staffs of MSE departments and national laboratories should be expected.

Women who are interested in MSE careers are lost at every educational transition, from middle school to full professorship. A comparison between large public and small private institutions reveals little difference. Similar pictures emerge for women at US national laboratories and at universities in the UK.

Implicit biases, unconscious attitudes, invisible factors and schemas influence decision making and continue to adversely affect the progress of women in MSE. Resolving these issues presents a major challenge that must be addressed to sustain the vibrancy of the field and provide the nation with adequate numbers of appropriately trained scientists and engineers.

Recommendations:

The following recommendations are made based on the outcomes of the discussions at the workshop. Many or all of these apply equally well to universities and national laboratories and should be considered in context of industrial environments as well.

First, there should be a follow-up process by which the University Materials Council (UMC) reviews the status of women in the field of MSE on a periodic basis and determines what additional changes should be made to accelerate progress in gender equity.

Second, all departments should strengthen documentation and enforcement of departmental procedures such that hiring, promotion, compensation, and tenure decisions are more transparent, that the reasons why a candidate was not selected or promoted are clear, and that faculty are less able to apply their biases to personnel decisions. Strict written rules and quantitative metrics may not be possible given the many factors that enter into all such decisions but written policies and clear communication would benefit everyone.

Third, all departments should strengthen mentoring of junior faculty. Mentorship should include both social and technical aspects of fitting into a department. Mentoring should accomplish the following: enhance productivity in research, grant writing, teaching, and other aspects of the career; improve interactions and collaborations with other faculty including improving acceptance of the faculty member into the social structure of the department; and promote the faculty member both within the department and externally by serving as an advocate and nominating the faculty member for awards.

Fourth, all departments must raise awareness of gender biases and work to eliminate hostile attitudes and environments that can make academic and national laboratory careers unattractive to women. This effort must range from teaching male undergraduates to be more respectful and inclusive to both female students and faculty, to enforcing gender-neutral behaviors on the part of faculty and staff.

Fifth, with respect to raising awareness among faculty, staff and students, a new type of training session should be developed that would be more effective in conveying the facts and consequences of gender bias than the conventional presentations typically available, which seem not to be highly effective in changing attitudes or behaviors. Any new training should make explicit the implicit, unintended, and generally unrecognized impact of some actions and behaviors.

Sixth, it is proposed that the UMC establish a certification of “family-friendly” or “gender equivalent” institutions that would encourage organizations to meet standards for minimizing gender bias and promoting supportive work environments. The approach would be for the UMC to develop “strawman” criteria for certification and then to involve professional societies and/or the National Academies in developing and/or endorsing the certification policies.

Family-friendly or gender equivalent requirements would encompass both “bricks and mortar” facilities as well as implementation of institutional policies such as those listed above. Any such policies should extend to both senior staff/faculty and junior staff/graduate students and should be compatible with environments at universities, national laboratories, and potentially, industry.

Seventh, novel approaches to adjusting job responsibilities of faculty, staff, and students to permit them to deal with family/life issues are

needed that do not carry stigmas. These must be implemented in such a way that all employees feel free to make use of them as needed without fear of damage to their careers. Institutions should develop clear and consistent modified-duty policies and ensure that they are applied without respect to the leave-taker's gender.

Finally, faculty and national laboratory staff need to promote the benefits of their careers to women so that a more positive image of the job of materials scientist or materials engineer is presented. Further, job requirements should be adjusted to reduce pressure on faculty/staff to reasonable levels, such that a career in academia or a national laboratory does not appear to preclude enjoyment of life outside of work.

Recommended Follow Up

The UMC should organize a follow-up workshop after sufficient time has passed, for example in 2011, to establish what if any changes have been made based on the current findings. The time elapsed before the next workshop should be long enough to allow substantive change but short enough to effect rapid progress.

In the interim, the UMC should gather and make available, as publically as reasonable, practices in use at member institutions and any best-practice recommendations that arise from a comparison of approaches in use.

The UMC should develop guidelines for creation of written standards, policies, and procedures to clarify standards for personnel issues such as hiring and promotion. In particular, these guidelines should emphasize mechanisms to minimize the effect individuals' explicit or implicit gender biases on personnel decisions.

A process for certification of institutions as meeting gender equivalent or family-friendly standards should be developed and implemented.

The follow-up workshop should take as a major focus the evaluation of the effectiveness of these recommendations and further improvements to them.

To move forward we need to continue talking and listening.

Overview

Gender equity issues represent major challenges for all science, technology, engineering and mathematics (STEM) fields. Women are historically under-represented in these fields, and their sense of integration in the community is often low. National workshops have been held previously to address these issues in physics and chemistry. The conclusions and recommendations of these earlier workshops have been posted on the Web.[5,6]

At the request of the University Materials Council (UMC), a national workshop was convened to examine "Gender Equity Issues in Materials Science and Engineering." The workshop examined causes of the historic underrepresentation of women in materials science and engineering (MSE), with a goal of developing strategies to increase the diversity of faculty in the discipline. Specific workshop objectives were to examine efforts to level the playing field, understand implicit biases, develop methods to minimize bias in all aspects of training and employment, and create the means to implement a broadly inclusive, family-friendly work environment in MSE departments.

The motivation for action is compelling. The nation's sustained economic prosperity and global scientific leadership can no longer afford to discourage participation by highly qualified members of the population. The quality of education provided to young materials scientists and engineers and the organizational effectiveness and scientific progress at universities and national laboratories are enhanced when diverse perspectives contribute to communication of ideas, decision-making, and problem solving.

The workshop was held May 18–20, 2008, at the Conference Center at the University of Maryland; the final program is included as Appendix I. There were 98 registered participants including 62 attendees representing 45 different universities and 11 attendees representing 9 national laboratories. The participants included representatives of the National Science Foundation (NSF) and the Office of Basic Energy Sciences of the Department of Energy (DOE-BES). A variety of other voices were represented as well, including women in MSE at an early stage of their careers, invited speakers, and representatives of MSE technical societies. Financial support was provided by the NSF Directorate of Engineering and the Division of Materials Research in the Math and Physical Sciences Directorate, the DoE Office of Basic Energy Sciences, and the Department of Materials Science and Engineering at the University of Illinois. The organizing committee included Dawn Bonnell, University of Pennsylvania, Diana Farkas, Virginia Tech, Ian Robertson, University of Illinois, Angus Rockett, University of Illinois, Susan Sinnott, University of Florida, and Judith Yang, University of Pittsburgh.

The workshop included formal presentations, panel discussions, and informal breakout groups. Participants were asked to develop recommendations to transform the climate for women within their home departments and institutions. Four primary themes were examined: the current status of gender equity in MSE, recognizing and understanding implicit biases, balancing work and family life, and comparisons of the industrial, academic, and national laboratory environments.

This document presents a detailed report on the workshop. Copies of speaker slides and other supporting documents are provided at http://www.mse.uiuc.edu/gender/index.htm. Follow-on discussions are being planned by the UMC to assess the progress made at member institutions and to develop a compendium of best practices.

The University Materials Council

The University Materials Council (UMC) is composed of department heads, chairpersons, directors, and group leaders from academic programs in the materials field in US and Canadian universities. The Council meets twice a year, once in spring and once in fall. It serves as a forum for leaders of materials programs to share best practices in areas such as student recruitment and to discuss issues such as ABET accreditation, emerging research areas, ideas for curricular improvements, intellectual property policies in universities, implications of the latest materials-related studies, and the health of research funding for MSE, as well as a variety of other issues of interest to the academic community. More information about the UMC is available on the Web at http://www.umatcon.org/.

David Clark of Virginia Tech is incoming chair of the University Materials Council.

Gender Equity in STEM Fields

Any workshop discussing gender bias in a particular community would benefit from an overview of the issue in a broader context. In a talk given by Susan Carlson, associate provost for faculty advancement and diversity at Iowa State University, statistical data from a variety of sources, but primarily from a survey of faculty conducted by Iowa State University's Office of Institutional Research, and based on a survey developed by the American Association of Universities Data Exchange (AAUDE), were presented.[3] The data demonstrate that women perceive that academic faculty positions are more stressful than do their male counterparts. The female respondents were less likely than males to feel that their colleagues valued their research, were more likely to feel excluded from the department social network, and were more likely to feel that their administration did not provide a collegial and supportive environment. An example of one of these survey response results is shown in Figure 1.

An approach used at Iowa State University (ISU) to address these concerns is based on a strong effort to monitor the status of women in science, technology, engineering, and mathematics (STEM). Problems are remediated based on approaches such as flexible definitions of scholarship, a clear "position responsibility statement" defining the duties of a faculty member, and a variety of approaches to modify the duties and timelines. The overall strategic goal of the Iowa State program is to "ensure that the university is a great place to learn and work".

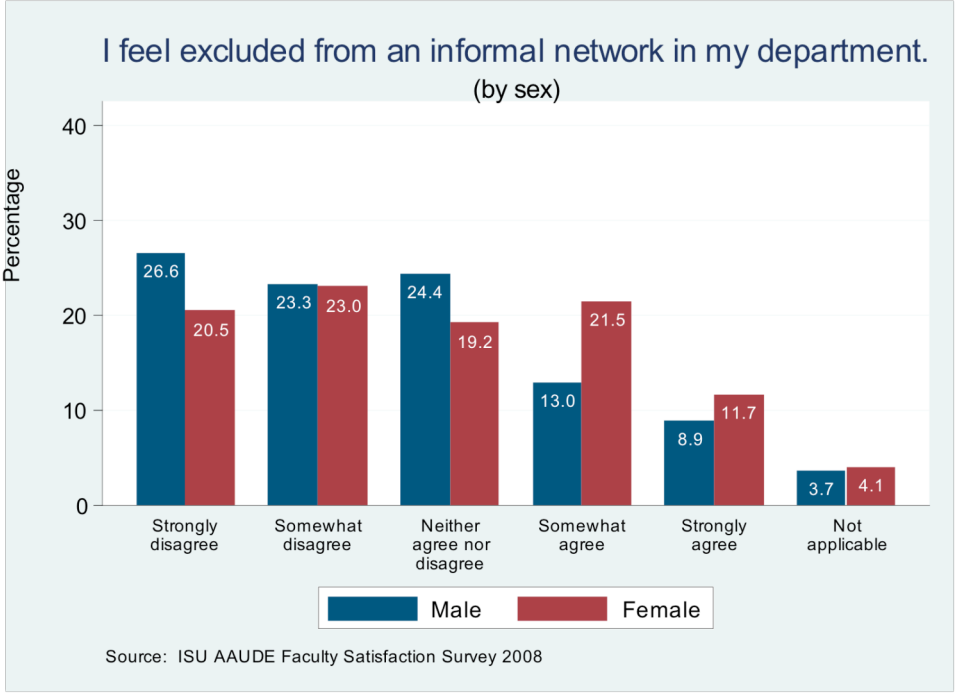


Figure 1: Results of the 2008 Iowa State University AAUDE Faculty Satisfaction Survey by gender on sense of inclusion in a departmental social network. [3]

Conveying how gender bias can influence the outcome of a young scientist's career, especially to a potentially skeptical audience, is difficult. Empathizing with individuals can help; for example, when one is a disinterested observer of a clearly biased process. To bring situations exhibiting gender bias most clearly to the attention of the attendees of the workshop, the Utah State University ADVANCE Interactive Theater Project performed a skit representing a hypothetical third-year review of a female faculty member.

The personality types of the hypothetical review committee ranged from senior male faculty whose behavior created a hostile environment for women, to female faculty who themselves contributed to the problem by setting unrealistic expectations for other women. During the skit, examples of exclusion of female faculty from the social structure of the group and from its discussions, and other explicit and implicit biases were illustrated. While the characters of the skit's committee were extreme, it was mentioned in the introduction of the skit that all of the incidents portrayed were based on real events. Therefore, while the hypothetical committee was a "perfect storm" of problems, it was unfortunately quite believable.

The theater group encouraged the audience to participate by giving them the opportunity to pose questions to the actors as themselves or in character. A lively discussion ensued. Listening to the audience throughout the remainder of the workshop, the traits portrayed by the hypothetical review committee members were clearly recognized in the community.

The impact of the skit on the attendees and their increased participation in the associated discussion serve as an example of novel approaches to educating individuals about gender bias beyond traditional training sessions. More effective training was identified during the workshop as an important goal for any program aimed at reducing gender bias. Awareness is a key issue, but traditional training methods were described by speakers at the workshop as relatively ineffective and may even engender a negative response among trainees. Therefore organizations may wish to consider methods such as an interactive theater presentation to raise awareness and increase sensitivity to gen-

The Utah State University Interactive Theater Troupe skit in action.

der bias issues.

There are a number of worrisome trends in STEM—notably that the number of both men and women choosing to go into academia is declining over time and that the average time that women stay in the academic profession is roughly half that of men (see Table I.)[4] Both women and minorities are found to be moving increasingly to nonacademic occupations, despite strong efforts at hiring and retention. Statistics supporting this conclusion were presented by Priscilla Nelson, provost and senior vice president for academic affairs of the New Jersey Institute of Technology.

Table I: The average academic "lifetime" in years for men and women in science and engineering

	Mean Career Age for S&E PhDs in Academe	
	Men	Women
1973	8.8	7.4
1979	11.3	6.4
1989	14.9	7.1
1995	15.1	7.2

Data from "Scarcity to Visibility: Gender Differences in the Careers of Scientists and Engineers (2001). [4]

To encourage participation by women in STEM fields, students need to believe that STEM is the path to a career that addresses issues important and relevant to society. This idea is not currently communicated effectively to women considering an academic career in STEM. This theme was echoed throughout the remainder of the workshop; in particular with respect to the common belief that women care more about group good and group interactions than with personal good, compared with the average man. Therefore, enhancing the sense that an academic career benefits the whole of society rather than individuals personally may make the career more fulfilling and attractive to women.

Universities face increasing budget short falls due to reduction of external support, tuition caps, declining returns on endowments, etc. As pointed out by Nelson, this raises an intrinsic problem for administrators in dealing with gender issues -- increasingly tight budgets constrain options for creative solutions to problems, especially when it comes to solutions that have costs associated with them, such as leave time. The current economic climate will only make this situation worse.

While budget issues constrain all aspects of departmental operations, they should not be taken as an excuse to avoid solutions to gender inequities. Administrators must find creative ways to deal with budget constraints. In the end, if we are to make STEM fields more attractive to women, it is essential that we ameliorate hostile environments, even if budget issues make action more difficult.

The status of women on faculties in MSE departments should be considered in the context of the progress made in STEM as a whole relative to the academic community as a whole. According to the National Science Board's *Science and Engineering Indicators 2008*,[2] between 1973 and 2006 "the number of women in academia increased more than eightfold, from 10,700 to about 90,700, raising their share from 9 percent to 33 percent."[2] (See Figure 2.)

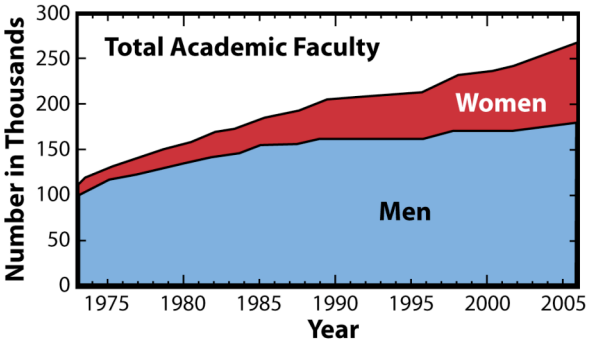


Figure 2: Total faculty in thousands. Women increased from 9 to 33% of the total.[2]

On the one hand, this increase represents significant real progress; on the other, three decades were required to achieve this level of participation. The difference with respect to the general population points to significant challenges in increasing the fraction of women in academia.

The fraction of female full professors in STEM disciplines is much smaller than the fraction of female associate professors, which in turn is smaller than the fraction of female assistant professors. Currently 12 percent of engineering tenured/tenure track faculty members are women (see Figure 3 for trend). The differences in the numbers at various ranks correlate to those in other disciplines: 6.3 percent of full professors, 13.2 percent of associate professors, and 19.5 percent of assistant professors being women. The American Society of Engineering Education (ASEE) reported that the percentage of women on engineering faculties in 2006 at eighteen "Big 10 plus" schools varied between ~8 percent and ~15 percent.[2] The decline in representation with increasing rank is true for both large and small universities. This result is consistent with the trend noted earlier that women tend to remain in the profession a shorter time.

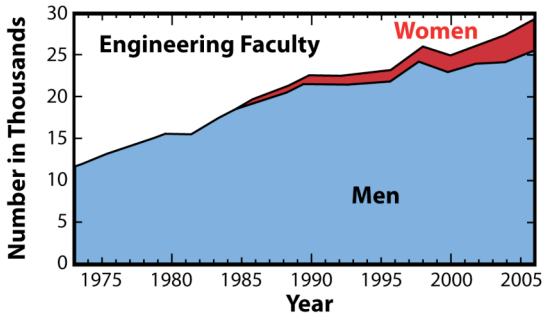


Figure 3: Faculty in STEM. Only 12% are women currently.[2]

The various statistics that characterize the participation of women in science and engineering are often represented in a manner that can be misleading when doing a self analysis of physical science fields. For example, *Science and Engineering Indicators 2008* reports that females comprise approximately 50 percent of the graduate students in 'Science, Engineering, and Health.[2] However, upon removing the health-related fields, the number is reduced to ~43 percent. This statistic is still misleading, in that the "science and engineering" category includes the social sciences. In fact, women represent only 19 percent of physics graduate students and 22 percent of engineering graduate students. Metallurgy, ceramics, and materials are slightly above the engineering average, with ~28 percent of the graduate students being female. This example illustrates that the correct context must be considered in analyzing any metrics of women in science and engineering.

Gender Equity in MSE

Based on the discussion in the previous section, it appears that it is important to consider gender equity discipline by discipline. A valuable place to begin to understand gender equity issues in MSE is the "pipeline." This answers the question of whether gender imbalance is supply limited or based on perceived unattractiveness of the career on the part of women. Dawn Bonnell, professor of materials science and engineering at the University of Pennsylvania, presented, among other topics, a discussion of pipeline issues.

The starting point in considering the pipeline in MSE is to examine the number of graduates at various ranks. Between 1983 and 2002, the annual number of bachelor's-degree recipients fell from 1392 to 933, with the percentage of women increasing from ~20 to ~30 percent (see Figure 4). Interestingly, the number of female bachelor's recipients has remained constant, resulting in the increased percentage. At the master's level, the number of graduates has fluctuated around 700, with the percentage of women ranging from 15 percent to 24 percent. Again, in recent years the number of women has remained roughly constant while the number of men receiving the master's degree has varied. In contrast to bachelor's and master's populations, the number of PhD degrees granted annually increased, from ~250 in 1983 to a maximum of almost 600, and nearly 500 in 2002. Women PhD recipients constituted only 4 percent of the cohort in 1983, but increased to ~21 percent in 2006. In terms of absolute numbers, the 2006 rate represents about 100 women graduates per year. While the percentage has been gradually increasing throughout the last 23 years, a larger rate of growth appears to have occurred in the early 1990s.[2]

Over this same time period, the number of women faculty in materials science increased from very few to the current level of ~12 percent, averaged over all ranks. Here it is useful to note that the population of master's and, to a greater extent, PhD students, includes graduates from disciplines other than materials science and engineering, implying that the "pool" of candidates for faculty positions in MSE is much larger than the number of students holding bachelor's degrees in the field. This observation is even more significant for faculty hiring. It is appropriate and sometimes extremely advantageous to add faculty to MSE departments who have degrees in chemistry, physics, electrical engineering, mechanical engineering, and related disciplines. Thus the pool of new graduates who are potential female faculty candidates is closer to 150 or 200 per year, although the pool of male competitors also increases. Nonetheless, a substantial

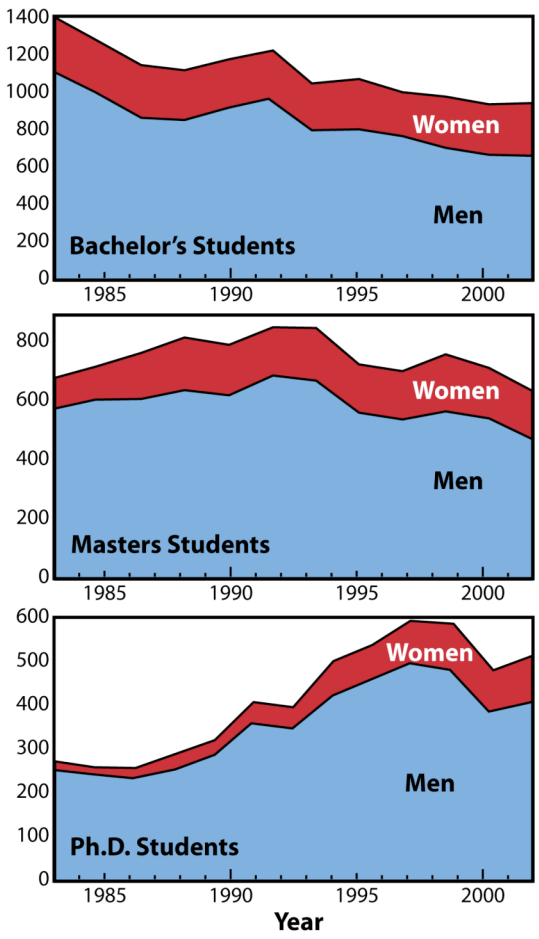


Figure 4: Trends for number of women and men in MSE from 1983 to 2002.[2]

number of female candidates are available, if a career in academia can be made attractive to them. Therefore the pipeline is not the primary limitation to greater representation of women in MSE faculty.

The impact of the statistics of small numbers must be considered in analyzing any metric in MSE. An anecdotal comparison of a small East Coast private university and a large Midwest public university illustrated that while large year-to-year fluctuations occurred in the fractions of females in the graduate programs in the smaller population, the trends and averages were nearly the same for both institutions.

Understanding Implicit Biases

If the pipeline is not the dominant issue, then the academic profession in MSE must be in some sense unattractive. In the absence of explicit biases, which are easily identified and corrected, implicit assumptions that we make about each other may contribute to the problem. To help the audience understand this issue, the workshop included two talks demonstrating how implicit biases can occur even in a well-meaning community.

Brian Nosek, professor of psychology at the University of Virginia, showed through video demonstrations and audience response tests that the workshop participants exhibited clear unconscious implicit biases. For example, the audience response time for sorting of words into categories was dramatically different when the sorting task either did or did not match typical stereotypic assumptions.

The demonstrations also showed how people, when asked to focus on a specific aspect of a video recording, can completely fail to notice an event that was clearly visible. It was evident that our minds selectively detect only those parts of a sensory stimulus in which we have specific interests and that our perception of the world is strongly influenced by our expectations.

To evaluate your own schmas try the tests at: http://implicit.harvard.edu/

To the surprise of the audience, these responses were independent of gender. It was explained that is, in fact, not surprising, as both genders exhibit implicit biases common to their society as a whole and that seeing what one expects to see is simply a reflection of how our minds work.

A major point of the talk was that people have built-in biases that allow them to manage the amount of information their senses provide. Thus, assigning people to categories is integral to our daily functioning, but doing so leads to both conscious and unconscious assumptions about individuals or groups of people.

To prevent these unavoidable stereotypes from causing hostile or biased environments in society, we must be aware of implicit biases and work actively to change or counteract them. It was noted in the presentation that some aspects of sensory perception can be corrected by mechanical means, such as eye glasses or hearing aids. We should be able to explicitly correct for our implicit biases in the same way we explicitly correct for poor eyesight and hearing.

With effort we should be able to correct for our implicit biases.

Gender bias has been shown to contribute to the differential in compensation men and women receive. For example, while men and women receive roughly equal starting salaries as they begin their careers, after about six years compensation and advancement diverges, with men doing better than women on every measure, even when matched for publications, research funding, teaching evaluations, and other objective measures of productivity and success. The only variable to account for the disparities is gender.[4, 7]

As an example of how such a disparity can develop, consider the following. Approximately 90 percent of women in STEM disciplines have working spouses. Because of the difficulty of moving their working spouses, women are less likely to seek other jobs than are men. As a result, the practice of granting pay raises as retention bonuses or in response to recruitment offers by other institutions tends to widen pay disparities between men and women.

In her presentation, Virginia Valian, professor of psychology at Hunter College, presented results showing the impact of implicit and explicit biases in the context of STEM as an explanation for gender disparities. While there is definitely a pipeline problem, it is not the commonly perceived "not enough women" problem, considered above. Rather, it is that women opt out of academic careers because they do not perceive the career as attractive, do not make as much money or advance as far as do equally qualified men, and find the culture of the STEM academic environment biased against them.

Family care is an issue for most faculty. Problems caused by lack of resources adversely affect academic women disproportionately, because they shoulder the primary responsibility for child and elder care in most families. Research has shown that in families where both parents work, fathers do not do half of the work at home.[8]

In spite of this, and somewhat surprisingly, women with children do not publish less than those without children, and women's productivity actually increases in terms of publications as the number of children increases, up to four (for women who remain full time faculty). Women without children do not do as well as men, with or without children. [8]

We have both implicit and explicit assumptions about what it means to be male or female. We are acculturated to think of men as independent, goal-directed doers and of women as communal, expressive nurturers. Consequently, there is "congruence" of our schemas concerning men and our expectations of professionals in STEM, and incongruence for women and STEM. The ideal scientist is perceived as having more "male" traits by both men and women.

Acculturation is sometimes raised as a prerequisite for advancement: "Once women get acculturated to the climate, they will rise at the same rate as men" implies that women should be expected to conform to an environment that favors "male" characteristics and behaviors. This expectation does not provide a supportive and inclusive environment. Any such expectation places a burden on women in STEM fields to conform in ways not expected of men. In addition, Valian presented the results of several research studies that demonstrate that women who act like men are penalized socially and economically, making the whole issue of acculturation a "no-win" situation for women.

Discussions in the hallway during breaks were valuable for exchange of ideas.

In a recent experiment on perception of women's competence, subjects read background information and evaluated a candidate for a position as a senior administrator of an aerospace company. In some cases, a prior performance review, which rated the candidate as "excellent," was provided in the background information, while some cases contained no performance review. Subjects were asked to rate each candidate's competence in the job and likeability. Without a performance review, men were rated higher for the position equally by both men and women. When an "excellent" performance review was included, all candidates were ranked higher, but the women were rated as less likeable. Both men and women exhibited this bias to the same degree. Furthermore, likeability was shown to be important—people reward people whom they like.[8]

In a second study, male undergraduates were asked to select a candidate for a job that

required both a strong engineering background and a history of working in the construction industry.[9] Of two applicants, one had more education, the other had more experience. When the candidates were identified only by initials, education was ranked as more important than experience. When the genders of the candidates were identified, education was preferred when the man had more education, but when the woman had more education, the results were skewed toward experience being more important.[8]

Everyone can think of women who are exceptions, which makes it easy to be misled by a few counterexamples into believing that a systematic problem does not exist.

Our gender schemas rely to a great extent on visual cues and are thus similar to stereotypes. In some cases, gender schemas work for us; for example, they allow us to predict how unknown people will behave. However, gender schemas can also supersede good intentions to treat women and men (or people categorized into groups in any other way) equally.

We have a pervasive tendency to perceive women as less likely to be leaders based on our schemas. As an example of this effect, consider the relationship of seating arrangement and perceived leadership. An example was given as follows.[10] When subjects were shown pictures of people around a table, when all were men or all were women the person at the head of the table was assumed to be the leader. If the photo was of a mixed group, a male at the head of the table was typically selected as the leader. If a woman sat at the head of the table, subjects typically assumed someone else was the leader. A woman has to work harder to identify herself as a leader. Eye contact behavior also can connote submission or leadership. The leader in a group looks around more than a subordinate. Men typically exhibit dominant gaze behaviors more than women under many circumstances.[11]

Having a leader in a given group actively and explicitly endorse gender equity before a group makes personnel decisions has been shown to be effective in minimizing gender bias. Implicit assumption tests, such as those developed by the Harvard project, can also make individuals more sensitive to implicit biases.

Expressing the opinion that things should be changed is not sufficient. Having good intentions can have the effect of masking bad behavior.

Based on the presentations in this part of the workshop, the most promising approach to mitigating behavior based on stereotypes and presumptions appears to be to increase awareness of these behaviors and to develop effective means for monitoring and assessing our behavior. More effective training is also needed. While people can learn to recognize and overcome implicit biases, conventional human resources training sessions are ineffective in the opinion of workshop participants.

While methods to educate about bias exist, they do not constitute a well-defined program demonstrated to reduce gender biases. Therefore a conclusion of the workshop is to recommend an active program to develop more effective training techniques.

Findings of the Georgia Tech ADVANCE project were presented by Carol Colatrella, project director and professor of literature and cultural studies at Georgia Tech. [12, 13] The objectives of the project were to establish networks of professors in various colleges at Georgia Tech, and to gather data on equity and bias in evaluations. The program also held workshops and conferences to develop: methods to improve family-friendly practices, methods for defining problems and issues, and strategies for their mitigation. Specific indicators were also identified to measure quantitatively issues related to gender bias.

The results of Mary Frank Fox's ADVANCE research studies at Georgia Tech indicated that

men are more likely than women to report speaking to colleagues in their department on a daily basis and to characterize their home unit as "exciting," "helpful," and "creative."[14,15] The studies included the conclusion that, in general, bias was not based on reasoned actions but on unconscious behaviors, consistent with the schemas described by Valian and Nosek.

A number of specific programs have been implemented at Georgia Tech including the ADVANCE program (2001-07), the 1999 creation of a Center for the Study of Women, Science, and Technology (WST) and the 2006 appointment of a Director of Faculty Career Development Services (FCDS). A group of ADVANCE professors have been appointed who serve as advisers and mentors to junior faculty. Together with WST and FCDS, the professors are tasked to support faculty development, enhance communication, and organize workshops on topics such as grant proposal writing. Family-friendly practices introduced include a child care center near campus, procedures for reduction of responsibilities, and creation of dedicated lactation rooms for the use of anyone associated with the University. Development of an extensive and effective mentoring and career development program is expected to have significant impact on the climate for women at Georgia Tech. Improved mentoring was generally agreed by participants in this workshop to be important, as described below. It is recommended that strong mentoring programs be instituted to improve the climate for women in MSE departments.

Carol Colatrella speaking at the workshop.

Balancing work and family life

Anecdotal evidence suggests that many female scholars believe that they do not have the time and flexibility they need for family issues. Indeed, many women in academia rank this as their greatest concern. Family issues include raising children, caring for sick and aging parents, and accommodating a spouse's job. Because academia is widely perceived as a high-pressure time sink, many women are not attracted to tenured or tenure-track jobs at all levels of the academic ladder. Academic institutions that are committed to promoting a diverse work force must find ways to provide an environment that supports family needs.

It is important for an academic administration to recognize that there is more to life than work and that well-being outside the workplace is essential to attracting faculty of both genders. Relieving excessive job pressure is also key to im-

Catherine Didion spoke on balancing work and family life at the workshop.

proving the overall "quality of life" for both faculty and students. The issue was introduced at the workshop through a talk by Catherine Didion senior program officer at the National Academy of Engineering, followed by discussion and break-out sessions. The topic also arose as part of other presentations, notably by Amanda Petford-Long in relation to the environment at national laboratories.

Expectations and gender roles have changed dramatically in the past 50 years, as Didion pointed out. For example she cited examples from "The Good Wife's Guide" from 1955, which emphasized women's roles as exclusively those of home-makers and supporters of their husbands. These expectations have changed faster than academic institutions have responded. Now it is a game of catch-up.

There are systemic differences in the experience and expectations of women compared with men in regard to family responsibilities. Some of the statistics cited by Didion include the following:

- 90 percent of spouses of women science and engineering faculty are employed full time, but less than 50 percent of the spouses of male faculty work full time. Consequently, male faculty are almost twice as likely to have a stay-at-home spouse who can handle family responsibilities, such as child or elder care.
- 78 percent of women academics rate "balancing work and family responsibilities" as their greatest challenge.
- In one study, 62 percent of women in STEM fields in academia were married to a scientist or engineer, making finding satisfactory jobs for both more challenging, especially in smaller communities where land-grant universities are often located. As noted previously, this also complicates career advances that would require moving to another institution, with consequences for salary levels.

Child rearing is generally coincident with the most productive years of an academic career and the years most critical to obtaining tenure. Post-doctoral training, often a necessary prerequisite for an academic career, may extend tenure even later. Because women in general have children well before age 40 and at the latest in their mid-40s, there is no option for motherhood that does not typically interfere with the tenure process. Furthermore, elder care is becoming increasingly important, falls disproportionately on women, and typically begins as child rearing ends. Even women who have tenure cannot expect lesser responsibilities sufficient to permit handling family issues. Indeed, it is not uncommon for demands of the job to increase after a faculty member has tenure. As shown in Figure 5, women across the board are more likely than men to have family responsibilities.[1]

Creating a Family-friendly Department: Chairs and Deans Toolkit is available for download from:

http://ucfamilyedge.berkeley.edu/toolkit.html

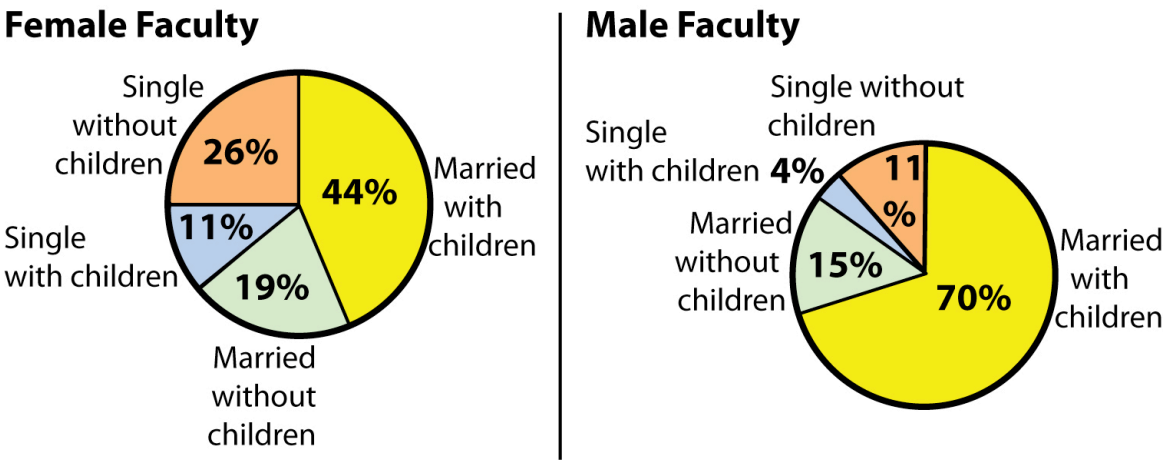


Figure 5: Pie charts showing the distribution of family status for all STEM faculty. [1]

For all of these reasons, family-friendly policies must be available on a career-long basis.

Single women are perceived to be generally more successful in academia than married mothers (despite the statistics cited by Valian suggesting that the reverse is true). Furthermore, women with children are less likely than those without them to obtain a tenure-track position and tenure.

Several national and international reports have addressed the issue of improving life-work balance in STEM disciplines. In *Mapping the Maze: Getting More Women to the Top in Research* (2008).[16] the European Commission made the following recommendations:

- Provide adequate child care facilities
- Assess and change the culture and policies of the organization related to time commitment.
- Tackle and reduce negative images of working mothers.
- Promote active fatherhood.
- Move away from an image of a scientist as being without family responsibilities.

In *Beyond Bias and Barriers* (2007),[17] the National Research Council of the US National Academy of Sciences endorsed the following activities to promote a better balance of life-work responsibilities in academia:

- Make institutional commitments to take corrective action.
- Collect data for the organization.
- Develop a campus framework for monitoring progress.

The American Association of University Professors has also made recommendations to enable all faculty to better balance work and family life (unpublished). These include:

- Provide paid leave for family care and emergencies.
- Permit active service with modified duties, such as reduced workload without loss of status.
- Establish formal institutional policies, not individual *ad-hoc* arrangements.

Didion also pointed out that women who take advantage of modified-duty policies must remain engaged with the department and with the profession while on leave or on reduced duties.

Discussion of the topic followed. Workshop participants believed that performance reviews can be less sympathetic to male than female partners who take parental leave or other forms of modified duties to meet family responsibilities. The group also recommended that tenure decisions be made on an integrated body of work rather than on an arbitrary output rate per year.

The strongest conclusion to come out of the discussion was that institutions should develop clear and consistent modified-duty policies and ensure that they are applied without respect to the leave-taker's gender.

Opportunities should be provided to explain publication gaps on performance reviews and funding applications. Most importantly, realistic expectations for performance should be established that are consistent with a reasonable work-life balance. Didion noted that these issues apply as much to national laboratories as to universities, and that a review of national laboratories showed inconsistent and uncoordinated rules for family leave across the organizations.

Colatrella provided examples from the Georgia Tech ADVANCE program of approaches that can be used to create a more family-friendly environment at a university, such as the construction of a childcare center near campus, implementation of procedures for stopping the tenure clock for family reasons, and the development of written modified-duties procedures. Colatrella also emphasized the importance of mentoring and presented examples of successful mentoring practices used at Georgia Tech. A useful tool developed at Georgia Tech related to mentoring is the ADEPT software that provides case studies for discussion, mentoring activities, and activities to reduce bias in faculty evaluations. Details may be found at http://www.adept.gatech.edu/. The mentoring activities were found to have a significant effect on female faculty retention by assisting them in navigating the promotion and tenure process and integrating them into the work environment. The improved ability of Georgia Tech to attract and retain high-quality female faculty as a result of these changes illustrates the impact of providing family-friendly environments. [12, 13]

Taking steps to improve family-friendly policies and modified-duties regulations at the institutional and departmental levels should be part of establishing trust in the tenure process—its fairness, consistency, and collegiality. Earning tenure is a long process that begins from the start of a junior faculty's employment at an academic institution. Clear written policies should be available to new faculty (and presumably to candidates for faculty positions) for the tenure evaluation process, including family leave or modified duties. Chairs should exercise zero tolerance towards inappropriate behavior during the evaluation process. The institution should provide training on proper evaluation methods and criteria for department chairs and faculty serving on promotion and tenure committees. Institutions should also make sure that the corresponding training has components specifically addressing gender bias and family issues.

As noted elsewhere in this document, the discussions related to balancing work and family life included the suggestion that policies for modified duties should avoid approaches that would reduce a faculty member's research output, if that is the primary basis on which they are judged. If at all possible, such policies should permit the faculty member to continue active research (for example from home) while reducing or eliminating other departmental responsibilities. For a teaching-oriented institution, nonteaching responsibilities should be reduced. It was suggested that these changes would reduce the perceived stigma associated with accepting reduced duties.

Comparative Environments

A comparison of gender equity in industry, national laboratories and universities suggests that the old adage, "the grass is always greener on the other side of the fence," holds for perceptions of workload in STEM as well. All major professional environments involve large weekly and annual time commitments. The public nature of universities and national laboratories makes their problems and opportunities much more visible than equivalent industrial enterprises.

It has been argued that industry environments give a sense of being both more welcoming and less pressured than academic environments, but this perception is not the case. Because students "grow up" in an academic environment, they have first-hand knowledge of the workload of academia. Most have not personally experienced industrial environments, so they have a sense that they could not be as bad. Therefore, one way to improve the impression students have of academia is to actively promote the advantages of the career to undergraduate and graduate students. As was pointed out, academia may require many hours per week, but a faculty member can largely choose which hours. Certainly the flexibility of the job is a major advantage compared with industrial positions.

In her presentation Britt Turkot, principal engineer and engineering group leader at Intel Corporation, discussed hiring and promotion in industry, and pointed out that women may be passed over for promotion because of a paternal attitude by management; for example, by stating that women with family obligations should not be given additional responsibilities. Turkot suggested a statement one might hear as: "She has two small children, we should not give her this assignment." This approach of making decisions for a woman with children does not offer her the choice nor does it support her desire to develop her career while managing family issues. Such paternalism should be unacceptable. Turkot also pointed out the ways in which industry can be more demanding of workers' time, such as working 24-hour shifts when production lines experience problems. However, unlike many academic institutions, industry provides "perks" to its workers that are important for women, such as improved access to child-care and free cab rides home after long shifts. This type of environment may be one reason why many women prefer industrial careers to academia.

Linda Horton speaking on the gender equity environment at national laboratories. Hussein Zbib (left) served as session moderator.

The situation with regard to gender equity at national laboratories was addressed by Linda Hor-

ton, director of the Center for Nanophase Materials Sciences at Oak Ridge National Laboratory (ORNL), and Amanda Petford-Long, group leader and principal investigator in the Materials Science Division of Argonne National Laboratory. The percentage of female staff members at these laboratories is of the same magnitude as in academia, although Horton noted that the situation at ORNL has been improving in recent years. However, the number of female staff members at the senior level is not very high for reasons that are very analogous to the situation in academia. Petford-Long also noted that the low number of senior women in MSE in academia is not limited to institutions in the United States, but is also observed in MSE departments in the United Kingdom. Many of the same driving forces are reflected in these institutions.

Susan Sinnott, professor of materials science and engineering at the University of Florida, noted some of the additional challenges faced by female faculty in academia. These include a lack of respect from largely male students and resentment by these students that female faculty are not more "nurturing," which is in line with their inherent gender schemas. These biases can truly be mitigated only by increasing the diversity of MSE faculties. Sinnott also indicated the importance of role models and spoke of how she was inspired by a female STEM professor as an undergraduate student.

Sinnott's observation that the attitude among male students can be a problem is consistent with surveys of female undergraduate students who cited hostile, inappropriate, or offensive behavior on the part of their male classmates as

Susan Sinnott speaking at the workshop.

the most common form of gender equity problem they encountered.

It was generally argued that for all three career options (industry, academia and national laboratories) the keys to recruiting and retaining women are: active and positive recruiting; flexibility in the face of family obligations; child-care facilities on site; opportunities for internships; strong formal and informal mentoring; clearly defined, gender-blind, and enforced policies for hiring and promotion; and a supportive social and community environment.

Discussions

During the workshop a number of discussions took place related to the oral session topics. Some questions raised and responses are summarized here.

- To enhance the acceptance of female candidates during the hiring process, their cases should be presented by the most powerful supportive faculty member, because a candidate is viewed more favorably

when her case is presented by someone more influential.

- A consistently described problem is poor mentoring of women. Although mentoring was an issue for both men and women, it was suggested that poor mentoring has more impact on women (especially as a result of gender bias problems). Development of very strong mentoring programs for women could improve their comfort level and ability to settle into their department. Issues such as understanding department politics can be greatly improved by mentoring. Mentoring should include teaching women strategic approaches to challenges in the workplace including techniques such as time management and survival strategies. Support for both strong individual mentors and committees of mentors was heard but no clear preference was evident and both approaches were perceived to have benefits.

- Championing women by the department administration can enhance development of their careers. Putting women in leadership positions, promoting their talents more actively, and rewarding them for their leadership activities can help build their reputations and establish their leadership careers.

One of the discussion groups meeting during the workshop.

- A sense of being part of their community was stated to be typically more important to women than to men. Therefore, improving mechanisms to increase social interactions, especially among the women faculty, is important to their sense of well-being. The sense of community can also be developed by increasing the sense of interdependence among members of a faculty.

- The panel discussion (Valian, Nosek, Abernathy, Bowman) indicated that women typically respond more strongly and look for positive feedback on their work more than men. Women's participation in service activities is to some extent driven by the greater feedback from the community. Feedback in other aspects of academic activities is very judgmental. More direct recognition of achievements in teaching and research by women could improve their sense of reward for these activities.

- One of the issues discussed is the effect of service activities on carrier advancement. It was noted that women tend to be assigned more service duties than men, in part because of a desire by administrators to maximize their representation on committees. It was suggested that women should seek service activities in key areas of hiring, promotion, and other topics that provide the maximum power to affect change and decline service in less important areas. It was suggested that women also should eschew routine tasks and to try to be the first one to work on a given problem or in a given area so that they can define the expectations related to that project themselves rather than having expectations assigned by others.

- The effect of women's social behavior was also seen to have career consequences. Women who appear self-aggrandizing are viewed more negatively than men

who behave this way. A woman who seems sad about a coworkers' bad performance is rated more highly than a woman who seems angry about bad performance. By contrast, displaying a sense of humor can be an advantage.

- With regard to balancing work and family life, it was suggested that more academic institutions create centers for work and family life. The establishment of such centers could help in changing the perception that an academic career can be incompatible with raising a family. Institutions could strive for the designation of "Family Friendly' if a set of clear guidelines for this designation were to be developed. Earning such a designation could provide motivation for institutions to take the issue of balancing work and family issues seriously.

- It was pointed out that one reason STEM has more difficulty with work/family balance is that taking time off to deal with family issues can leave an individual farther behind and out of touch than is the case in many fields because of the fast pace of advances in STEM. Therefore, it was suggested that rather than a complete leave of absence for family issues, care-givers should be granted relief of specific duties, such as teaching and/or committee service but be encouraged to maintain an active and productive research program so that they keep up to date on their field.

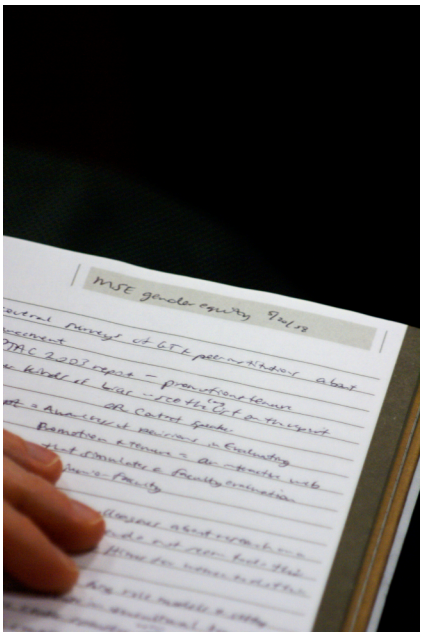
Breakout Groups

Following many of the lecture sessions the attendees were divided into small groups and asked to discuss questions listed in Appendix II. From these discussions, a number of comments and recommendations arose.

A significant part of the discussions could be divided into two areas -- increasing the pool of potential applicants, making the job more attractive so that qualified women will consider academic careers, and enhancing the chance that a woman who applies for a position will be considered favorably.

Concerning increasing the number of women in MSE in general, and ignoring pre-college pipeline issues, active efforts to promote MSE to women as a relevant field of study and explaining what is studied and taught in the field would reduce anxiety among potential applicants. To increase the range of applicants, listings should emphasize new areas in MSE, such as biomaterials, that can draw applicants from a wider range of backgrounds.

To attract women to the faculty, descriptions of departments should feature family-friendly and spousal hiring policies so that applicants for whom these are relevant are kept informed of options. It is also important that transitions from non-tenured positions to tenure-track appoint-



Participant notes were valuable in preparing this summary.

ments be possible. To help candidates appreciate the positive aspects of teaching, there should be mandatory supervised teaching experiences for graduate students. This would also permit candidates to assess teaching as a career.

To improve the perception of "quality of life" in academia, it was agreed that it would help to reduce expectations for workload generally, which make the job unattractive for anyone. At the same time it is important to develop a community feeling to reduce the sense of isolation both among women faculty in particular and in departments as a whole. Any new faculty member will feel more comfortable and supported if he or she feels a part of the Department and University communities as quickly as possible.

To enhance the chance of acceptance of female candidates for academic jobs, women graduate students should be coached and mentored to prepare them more effectively for the interview process. A candidate should be presented to the department for consideration by someone of authority, and the decision on hiring should not be made in haste. Interviews and hiring should be based on well publicized, unbiased and transparent selection criteria upon which the candidate should be evaluated. Criteria should be broad enough to encompass all approaches to success rather than being so narrow that they arbitrarily exclude the approach of a given candidate. It is important that both hiring and promotion and tenure committees should have a diverse gender makeup (as well as as much diversity in other respects as possible).

Listening to each other was a key to the success of the workshop.

As noted above, making the job of faculty member attractive involves improved family-friendly programs. A broad spectrum of family-friendly policies and facilities, not just childcare, should be available and structured to help both men and women across the spectrum of jobs as faculty, staff, and students. This should include emergency care facilities, not just routine care, so that employees can rely on care when they need it. Emergency care would allow faculty and students to accept assignments with more confidence. Accepting tasks is important to how a faculty member is perceived. Likewise, functions such as departmental meetings should be scheduled during normal working hours as much as possible so that employees can attend without interference with family duties. Finally, efforts should be made to permit employees to bring children to work if necessary.

A number of recommendations were made during the discussions to improve the success and retention of female faculty once hired.

First, faculty should receive comparable salaries for comparable contributions. To the extent possible, it is important to develop and publish guidelines for setting salaries.

Second, the tenure process should be transparent, with objectives and metrics as well-defined and quantifiable as possible. The associated evaluations should strive for consistency. Evaluations should promote success rather than punish failure. Evaluation committees should receive training on gender equity prior to conducting their evaluations. In case of negative evaluations, the basis for comparison should be clear and letters reporting results to candidates should contain specific reasons for failure to meet standards. This approach would strengthen confidence in the fairness of the promotion and tenure process.

Third, an improved process of mentoring and career development could greatly enhance the integration of female faculty into their department. To begin this process, mentors should be assigned to all assistant professors. In particular, proposal writing skills and self-promotion should be emphasized as these are key skills for any young faculty member. Guidance should be provided on how to navigate the funding agencies so that proposals are targeted to appropriate agencies and funding programs. Mentors should not neglect the social side of the job. Young faculty members should be integrated into the departmental social structure. Mentors should facilitate and seed collaborations to bring women into teams of colleagues, thereby increasing their sense of community. Mentoring should include methods for dealing successfully with family/life issues. The mentor should take a lead in nominating young faculty for awards and honors. Finally, many aspects of mentoring are available through professional societies, which can supplement departmental efforts.

To increase the impact of a young faculty member's time, committee assignments should focus on high-value high-profile activities. This is even more important for women faculty receive more committee assignments than men to ensure greater diversity on committees.

There was considerable discussion concerning family leave, and a definitive set of recommendations was not obvious. However, some points were clear. For example, a system of reduced responsibilities should be available to all employees dealing with family/life issues. Reduced duties should be available whenever needed and not on a limited basis. Compensation and expectations of an employee should be prorated based on the time duration and scale of the reduced responsibilities. Reductions in responsibilities should not be counted against other leave, such as sabbaticals.

It is important to develop mechanisms to avoid stigmatizing those who opt to use family leave options. The opinion was frequently expressed that implicit stigmas are associated with conventional reduced responsibilities and that this strongly discourages faculty members taking advantage of them. It was generally agreed that new methods should be developed that would allow faculty to deal with family issues without expecting or experiencing stigmas.

Finally, it was suggested that organized mechanisms to increase awareness of gender bias would reduce problems. Raising awareness could include requiring training for all leaders and faculty and staff involved in making decisions related to hiring, promotion, and tenure. Inappropriate comments should be reprimanded immediately and in a semi-public fashion to make everyone aware that it is unacceptable behavior. Procedures should also be developed for ongoing feedback, such as exit interviews and record keeping to establish reasons why women leave MSE.

Survey Results

Surveys were obtained from the workshop attendees before and after the meeting by the COACh program at the University of Oregon. A full summary of the results in chart format is provided on the workshop web site. The survey results were compared with prior results obtained from the Physics and Chemistry communities in conjunction with the workshops they held. Some of the notable conclusions are as follows:

- Department heads and other workshop participants surveyed generally considered the problems women face to be less important than the women in the chemistry community surveyed as part of the chemistry workshop.
- Notable exceptions to this finding were questions about balancing professional and family obligations, having too few female colleagues, and accumulation of subtle biases over years, all of which were considered important by all respondents.
- Having few female applicants for positions was judged to be much less important in MSE than in chemistry or physics. Otherwise responses from all three communities were very similar.
- Attitudes concerning the topics surveyed were relatively unchanged as judged by asking similar questions before and after the workshop. This was similar to the results of the Physics workshop, while attitudes in the Chemistry community changed significantly.

Appendix I: Program

Workshop on Gender Equity in Materials Science and Engineering

May 18-20, 2008

College Park, Maryland

Final Program

Sunday May 18, 2008

3:00 – 5:00 pm Registration & welcome reception

Session 1: Current status of gender issues at universities

Moderator: Dawn Bonnell. Scribe: Susan Sinnott.

5:00 pm – 5:45 pm	Welcoming remarks
	Angus Rockett, University of Illinois
	Richard Buckius, NSF Engineering
	Eric Rohlfing, DOE
	Tony Chan, NSF MPS
5:45 pm – 6:15 pm	Susan Carlson
	Associate Provost for Faculty Advancement and Diversity
	Iowa State University
6:30 pm – 7:30 pm	Dinner
7:30 pm – 9:00 pm	Utah State University – ADVANCE Interactive Theatre Project
9:00 pm	Adjourn

Monday, May 19, 2008

7:00 am – 8:00 am	Continental breakfast available
7:50 am – 8:00 am	Welcoming remarks (Judith Yang)

Session 2: Current status of gender equity in materials science and engineering

Goal: setting the stage for the workshop by defining the problem first in a general sense and then for MSE specifically. The presentation by Bonnell will utilize the statistics gathered annually by the UMC as well as statistics from other sources such as ASEE and NSF.

Outcome: understanding the magnitude of the problem.

Moderator: David Clark, Virginia Tech. Scribe: Diana Farkas.

8:00 am – 8:30 am	Priscilla Nelson
	Provost, New Jersey Institute of Technology
	Research Universities in a Time of Change – Can We Continue Progress on Gender Equity in Science and Engineering Disciplines?
8:30 am – 8:45 am	Discussion
8:45 am – 9:15 am	Dawn Bonnell
	University of Pennsylvania
	Status of Women in MSE
9:15 am – 9:30 am	Discussion
9:30 am – 10:00 am	Break/informal discussion

Session 3: Understanding Biases

Goal: To educate administrators that the problem is deeper than just the numbers. Nosek's talk entitled "*Mind Bugs"* will introduce the problems associated with *implicit biases or unconscious attitudes* and the role they play in shaping our actions and decisions. The second talk by Valian continues this theme by documenting how invisible factors or schemas impact the progress of women.

Outcome: Understanding "how our perceptions are skewed by gender schemas." This understanding will enhance how we as people and administrators perceive ourselves and others. The panel lead discussion will expand on this issue and will include methods by which some universities are tackling the problem.

Moderator: Gary Messing, Penn State University. Scribe: Susan Sinnott.

10:00 am – 11:00 am	Brian Nosek
	The University of Virginia Dept. of Psychology
	Mind Bugs
11:00 am – 11:30 am	Virginia Valian
	Hunter College
	Why So Slow? The Advancement of Women
11:30 am – 11:50 am	Discussion

Moderator: Peter Voorhees, Northwestern University. Scribe: Angus Rockett.

11:50 pm – 12:30 pm Panel Discussion

Keith Bowman, Cammy Abernathy, Brian Nosek, Virginia Valian

Working lunch, breakout groups and discussion:

12:30 pm – 1:30 pm Breakout sessions over lunch to discuss issues. Specific questions will be provided to the breakout groups and each will have a moderator and a scribe.

1:30 pm – 2:00 pm Coffee break. Scribes meet to condense and summarize key findings from breakout group.

Moderator: Amy Moll, Boise State University. Scribe: Susan Sinnott

2:00 pm – 3:00 pm Reconvene to review results of breakout groups. Presentation by one or two scribes of the key findings from the breakout groups followed by discussion.

Session 4: Balancing Work and Family Life

Goal: Gaining appreciation that there is more to life than work. Happiness and well-being outside the work-place are essential to attracting faculty of both genders and improving the "quality of life."

Outcome: Better understanding by administrator, who are essentially all "old school," that changes have occurred and they need to be taken into account.

Moderator: Rudy Buchheit, The Ohio State University; Scribe: Judith Yang.

3:00 pm – 3:30 pm Catherine Didion

National Academy of Sciences

"Balancing Work and Family: Moving from a Tight Rope to a Paved Four Lane Highway."

3:30 pm – 3:40 pm Discussion

3:40 pm – 4:40 pm Breakout session. Specific questions will be provided to the breakout groups and each will have a moderator and a scribe.

Moderator: Kevin Jones, University of Florida. Scribe: Dawn Bonnell.

4:40 pm - 5:00 pm Scribes meet to summarize key findings.

5:00 pm – 6:00 pm Discussion.

6:30 pm Dinner

Tuesday May 20, 2008

7:00 am – 8:00 am Continental breakfast available

8:00 am – 8:10 am Opening remarks (Diana Farkas)

Session 5: Improving the University environment

Goal: Learning how to provide a recruitment package that will appeal to females and changes to the tenure systems that are being considered at some institutions.

Outcome: Attracting females to academe and national laboratories and changing institutional culture.

Moderator Helen Chan, Lehigh University; Scribe: Dawn Bonnell.

8: 10 am – 8:40 am	Carol Colatrella
	Georgia Tech
	Equity in Promotion and Tenure at Georgia Tech
8:40 am - 9:00 am	Discussion

Session 6: Current Approaches to Gender Equity

Moderator: Huseyin Zbib, Washington State University; Scribe: Diana Farkas.

Goal: learning about best practices or areas needing attention for women who have managed to overcome the barriers and biases and are successful in their careers. Each participant will be asked to give their perspective.

9:00 am – 9:15 am	Britt Turkot
	Intel, Portland Oregon
9:15 am – 9:30 am	Linda Horton
	Oak Ridge National Laboratory
9:30 am – 9:45 am	Susan Sinnott
	University of Florida
9:45 am – 10:00 am	Amanda Petford-Long
	Argonne National Laboratory
10:00 am – 10:20 am	Break

10:20 am – 11:20 pm Breakout groups. Defining the key action items to address gender equity issues at their institution.

11:20 pm – 11:40 pm. Scribes convene to summarize key findings.

11:40 pm – 12:20 pm Report and Discussion

Moderator: Greg Rohrer, Carnegie Mellon University. Scribe: Judith Yang.

12:20 pm – 12:30 pm	Concluding remarks, David Clark, Virginia Tech.
12:30 pm – 1:30 pm	Lunch
1:30 pm	Workshop adjourns
1:30 pm – 4:30 pm	Workshop coordinators meet to draft preliminary results of the workshop.

Appendix II: Breakout Questions

Breakout session 1. Bias, Pipeline, Career.

Q.1. The number of women in MSE is amongst the highest in engineering but are still not representative of the population.

Identify the strengths of the profession that make it attractive to women.
How do we increase the number of women interested in the discipline?
Identify the factors that cause women to leave the profession.
What strategies can be implemented to minimize or eliminate these factors?

Q.2. The number of women pursing faculty positions in MSE remains a small percentage of the faculty at most institutions, and while individual units have experienced growth the overall numbers have not changed significantly.

Are positions in academia/national laboratories attractive to women?
If yes, why have we seen no growth in the total number?
How can professional organizations, search committees, and individuals better identify qualified female candidates for faculty positions?
How can we better prepare women graduate students for faculty positions?
If no, what has happened to make this career path less appealing?
What constraints exist at the department, college, and institution level?
What constraints exist at the national laboratories?
Identify the constraints and propose tractable solutions to the problem.

Q.3. We learned about discrimination and biases that can be intentional or subtle.

What policies and practices can we introduce within our respective organizations to learn about, identify, and then eliminate gender biases?
What changes can be made in the workplace environment to make it more comfortable for women?
What hiring and interview strategies work to eliminate gender bias?
How do new faculty, especially women, become connected to the university and faculty community? Can we improve these connections?

Q.4. Annual performance evaluations play an important role in the promotion and tenure of faculty and research scientists. How can we ensure we have effective and unbiased strategies for conducting performance evaluations? Do we have examples of best practices? Do we have effective comparison methods, to ensure that faculty have comparable salaries for comparable contributions?

Q.5. What are the best strategies for mentoring women for successful careers in an academic and/or national laboratory environment? What are the mentoring needs of female post doctoral fellows, assistant and associate professors, research scientists, and instructors? How do we best develop leadership qualities to encourage qualified, interested women to move to leadership roles (department heads, deans) in academia? Do we follow best practices for mentoring *all* our young faculty?

Breakout session 2. Striving to balance work and family issues.

Q.1. How can we help women faculty balance work with raising a family or with other life issues?
What are the costs of an academic career to an individual's personal life? What are the benefits of an academic career to an individual's personal life? How has this changed over the years? Under what conditions do you recommend that a graduate student / post-doctoral fellow consider pursuing an academic or national laboratory career?

Are our family-friendly policies known and accepted by administrators and faculty, used without misgivings, and effective? If no, what can we do to change that situation? If the policies are effective at your institution, what makes them so? Does the use of them prejudice performance reviews? Are they available to both men and women? Do men and women use them differently?
Are part-time positions feasible and how would this impact the tenure clock and the tenure decision?

Q.2. Our field is advancing at an ever-increasing pace and being out of the field for even a few years can be major setback. A consequence of this rapid advancement is that it makes it difficult for women to return to an academic/research scientist career after an extended absence. Is there or should there be a mechanism to help bring them back into the research/academic environment?

Q.3. What practices can we introduce into the operation of our departments to make them more family-friendly?

Q.4. What aspects of performance reviews are affected by use of family-friendly policies, such as tenure roll-back, modified duties after the birth or adoption of a child, part-time positions? How are gaps in publication records viewed? Is our tenure and promotion system flexible enough to equitably handle some variation in productivity?

Q.5. Some women (and men) choose non-tenure track academic options, e.g., research scientist, instructor, as a means to balance work/life issues. Could we encourage a path from these to tenure track positions? Could we encourage women in industry to consider moves to tenure track positions?

Breakout session 3.

Materials Science and Engineering action plan for attaining gender equity.

1. Increasing awareness of the discipline to increase the numbers.
2. Encouraging more women to remain in and pursue careers in the discipline.
3. Recruiting, hiring, retaining and promoting women faculty in a fair and effective manner.
4. Increasing awareness amongst our faculty on the issues impacting women. What actions can we as department heads take to eliminate biases on hiring, evaluation and promotion decision?
5. Is change at the Departmental or Institutional level needed to create a family oriented environment and a culture that is conducive to the success of women faculty? What changes are needed and how do we make them happen?
6. How do we monitor the impact of these changes on our profession? Who will assume responsibility for gathering and disseminating the data?
7. How will we assess the impact of this workshop? Should we plan further workshops on diversity with follow-on meetings on gender equity, diversity etc.
8. Developing partnerships with Professional Societies to further gender equity issues.

We need to prioritize our actionable items. What action items should be implemented to improve the situation in the short-term and in the long-term?

Appendix III: Participants

last name	first name	affiliation
Federal agency representatives		
Akkara	Joseph	National Science Foundation
Blevins	Linda	Department of Energy, BES
Buckius	Richard	National Science Foundation
Chan	Tony	National Science Foundation
Fischer	Anne	National Science Foundation
Gersten	Bonnie	Department of Energy, BES
Glownia	Jim	Department of Energy, BES
Haworth	Lance	National Science Foundation
Juhas	Mary	National Science Foundation
Kafafi	Zakya	National Science Foundation
Kerch	Helen	Department of Energy, BES
Kortan	Refik	Department of Energy, BES
Kramer	Laura	National Science Foundation
Kung	Harriet	Department of Energy, BES
McCloud	Kathleen	National Science Foundation
Rohlfing	Eric	Department of Energy, BES
Venkateswaran	Uma	National Science Foundation
Vetrano	John	Department of Energy, BES
Invited Participants not speaking		
Farrar	Gabby	Virginia Tech
Goldman	Rachel	University of Michigan
Heilshorn	Sarah	Stanford University
Kathan	Kendra	University of Pennsylvania
Liddell	Chekesha	Cornell University
Milam	Valeria Tohver	Georgia Institute of Technology
Schauer	Caroline	Drexel University
National Laboratory representatives not speaking		
Ajo-Franklin	Caroline	Lawrence Berkeley National Lab
Alper	Mark	Lawrence Berkeley National Laboratory
Beers	Kate	National Institute of Standards and Technology
Exarhos	Gregory	Pacific Northwest National Laboratory
Gutierrez	Carlos	Sandia National Laboratories
Johnson	Peter	Brookhaven National Laboratory
Lograsso	Thomas	Ames Laboratory
Sarrao	John	Los Alamos National Laboratory
Zinkle	Steven	Oak Ridge National Laboratory
Organizers not speaking		
Farkas	Diana	Virginia Tech
Rockett	Angus	University of Illinois
Yang	Judy	University of Pittsburgh
Speakers		
Abernathy	Cammy	University of Florida
Bonnell	Dawn	University of Pennsylvania
Bowman	Keith	Purdue University
Carlson	Susan	Iowa State University
Colatrella	Carol	Georgia Institute of Technology
Didion	Catherine	The National Academies
Horton	Linda	Oak Ridge National Laboratory
Nelson	Priscilla	New Jersey Institute of Technology

Nosek	Brian	University of Virginia
Petford-Long	Amanda	Argonne National Laboratory
Sinnott	Susan	University of Florida
Turkot	Britt	Intel
Valian	Virginia	Hunter College & CUNY Grad Ctr.
University Materials Council representatives		
Allen	Emily	San Jose State University
Andrews	Barry	University of Alabama at Birmingham
Baker	Shefford	Cornell University
Birnie, III	Dunbar	Rutgers University
Briber	Robert	University of Maryland, College Park
Buchheit	Rudy	Ohio State University
Buckhout-White	Susan	University of Maryland
Butt	Darryl	Boise State University
Cammarata	Robert	Johns Hopkins University
Carter	Barry	University of Connecticut
Chan	Helen	Lehigh University
Clark	David	Virginia Tech
Clemens	Bruce	Stanford University
Dudley	Michael	Stony Brook University
Edwards	Doreen	Alfred University
Floro	Jerry	University of Virginia
Genalo	Lawrence	Iowa State University
Goorsky	Mark	University of California, Los Angeles
Green	Peter	University of Michigan
Hull	Robert	Rensselaer Polytechnic Institute
Jones	Kevin	University of Florida
Kassner	Michael	University of Southern California
Kennedy	Molly	Clemson University
Komives	Claire	San Jose State University
Mahajan	Subhash	Arizona State University
McGuffin-Cawley	James	Case Western Reserve University
Messing	Gary	The Pennsylvania State University
Moll	Amy	Boise State University
Palazoglu	Ahmet	University of California, Davis
Plichta	Mark	Michigan Technological University
Pochan	Darrin	University of Delaware
Prorok	Barton	Auburn University
Reddy	Rama	University of Alabana-Tuscaloosa
Rigsbee	Michael	North Carolina State University
Robertson	Brian	University of Nebraska-Lincoln
Robertson	Ian	University of Illinois
Rohrer	Gregory	Carnegie Mellon University
Snyder	Robert	Georgia Institute of Technology
Warnes	Bill	Oregon State University
Wittig	Jim	Vanderbilt University
Xu	Ting	University of California, Berkeley
Zavaliangos	Antonios	Drexel University
Zbib	Hussein	Washington State University
Staff		
Brya	Cindy	University of Illinois
Elliott	Celia	University of Illinois
Professional society representatives		
Byko	Maureen	TMS
Powell IV	Adam	TMS
Predith	Ashley	MRS Bulletin

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