American Behavioral Scientist
53(7) 997–1012

DOI: 10.1177/0002764209356234
http://abs.sagepub.com

Women and Men Faculty in Academic Science and Engineering: Social-Organizational Indicators and Implications

Mary Frank Fox[1]

Abstract

Drawing on recent survey data of women and men faculty in doctoral-granting departments in computer science, engineering, and science fields in nine highly ranked research universities, this article depicts four key social-organizational features of work, as reported by women and men respondents: frequency of speaking with faculty about research in home unit, ratings of aspects of position and department, characterizations of departmental climates, and levels of interference experienced with work and family. The article points to (a) the ways in which these features of work are consequential for significant status in academic science and engineering; (b) the ways in which experiences with these features vary for women and men faculty; and (c) the ways that institutional practices and policies, reflecting these features, may be improved toward greater equity for the full participation and status of both women and men in academic science and engineering.

Keywords

academia, engineering, faculty, gender, organizations, science, women

The participation and status of women, compared with men, faculty in academic science and engineering have been pressing social concerns in the United States, in particular over the past 25 years. This concern is rooted in two basic sets of issues: (a) the provision

[1]Georgia Institute of Technology, Atlanta, USA

Corresponding Author:
Mary Frank Fox, School of Public Policy, 685 Cherry Street, Georgia Institute of Technology, Atlanta, GA 30332-0345
Email: mary.fox@gatech.edu

of human resources for the science and engineering workforce, and (b) social equity in access to and rewards for professional participation in these fields.

As human resources, women are important to the size, creativity, and diversity of the scientific and engineering workforce, broadly (Hanson, 1996; Pearson & Fechter, 1994). Women faculty, specifically, contribute to the culture and climate of the university and to the development of students' capacities and potential in science and engineering—with potential consequences for future generations of scientists and engineers.

In undergraduate education, the percentages of women among undergraduate majors and degree recipients in science and engineering are associated with the percentages of women faculty in these fields, and the growing trajectory over time in the percentage of women among science/engineering majors has been somewhat steeper in the presence (compared with absence) of larger percentages of women faculty (Sonnert, Fox, & Adkins, 2007). This provides empirical support for the long-standing discussion that women faculty "role models" are beneficial for the participation of women undergraduate students (Astin & Sax, 1996; Stake & Noonan, 1983; Xie & Shauman, 1997).

Furthermore, in graduate education in science and engineering, women faculty are consequential because of whom they train and the ways in which they do so, pointing to reasons that it matters to have women (as well as men) faculty (Fox, 2003). In my survey of 1,215 science/engineering faculty in doctoral granting departments in the mid-1990s, women faculty reported acting as primary research advisors for a larger number of female graduate students than did men. Among faculty doing "team research" (and that is 70% of the respondents in these science/engineering fields), women faculty have more female students on their research teams. They also have as many male students on their teams as do men faculty, and thus, on average, they are not substituting female for male students but include students of both genders and have larger teams. In addition, women faculty put significantly more emphasis on giving help to advisees across areas, not only in designing, executing, and publishing research but also in gaining social capacities, including participating in laboratory meetings, making presentations, and interacting with faculty (Fox, 2003).

The participation and status of women faculty is also a pressing, national issue for reasons of social equity (or inequity) in access to, and rewards gained in, science and engineering. This relates to the "ethos" articulated more than 65 years ago (Merton, 1942/1973) that scientific careers should be "open to talent" and not precluded by personal characteristics such as gender and race. This system of belief about scientific careers being "open to talent" continues to underlie part of the appeal for public support of science and helps justify the federal investment in science (Fox, 1999)—although status and rewards in science do not accrue independently of gender as discussed in this article and documented in a substantial corpus of research (see reviews in Long, 2001; Long & Fox, 1995; Sonnert & Holton, 1995; Xie & Shauman, 2003; Zuckerman, Cole, & Bruer, 1991).

Women in academic science and engineering are a highly accomplished group who have already survived series of selection—both their own self-selection into scientific fields and selection by educational and employing institutions. They have completed

Table 1. Percentage of Doctoral Degrees Awarded to Women, by Decade and Broad Field

	Time Period				
Field	1960–1969	1970–1979	1980–1989	1990–1999	2000–2004
Engineering	0.4	1.4	5.9	11.2	16.9
Earth/atmospheric	1.6	6.3	16.3	22.9	31.9
Physical sciences	4.8	7.7	15.1	21.5	25.8
Math/computer science	5.9	10.1	14.8	19.3	23.5
Biology/agriculture	11.4	18.2	29.1	38.1	43.6
Social sciences	20.4	32.1	49.4	63.4	67.1

Source: Commission on Professionals in Science and Technology (2006), Table 3-26.

doctoral degrees and have credentials for professional work. The measure of doctoral degrees awarded to women points to progress among women in science and engineering. By the decade of the 1990s, women attained 11% of doctoral degrees awarded in engineering; between 19% and 23% in earth/atmospheric, physical sciences, and math/computer science; 38% in biology and agricultural sciences; and more than 60% in social sciences (see Table 1).

However, the highest career attainments tend to elude this socially selective group. Despite the increases in doctoral degrees awarded and the passage of time, as of 2003, women still represented less than 10% of the full professors in mathematics, statistics, and physical sciences and less than 5% in engineering. Life sciences have a higher percentage of women faculty overall, but women remain less than 20% of the full professors in these fields as well. Only in social sciences are women more than 20% of the full professors (see Table 2).

These data point to issues of significant participation and rank for women faculty. Significant participation refers not merely to the "presence" of women faculty but also to influence and involvement in institutional decision making on issues including the curriculum, hiring of faculty, allocation of resources, and strategic planning within units (Fox & Colatrella, 2006). In understanding the participation and status of women in science and engineering, personal/individual factors—such as education, background, and ability—play a part. But individual characteristics do not exist in a social vacuum and, by themselves, explain little of the career experience and outcomes of women, compared with men, in academic science and engineering. For example, no direct relationship has been found between measured creative ability or intelligence and research productivity among those in scientific fields (Andrews, 1976; Cole & Cole, 1973). Rather, organizational conditions in the workplace are important for innovative and productive outcomes among individuals. These organizational conditions include autonomy in decentralized environments (Boardman & Bozeman, 2007; Corley & Gaughan, 2005; Glynn, 1996), freedom in the conduct of work (Amabile, 1988; Amabile, Conti, Coon, Lazenby, & Herron, 1996), a pool of resources in excess

Table 2. Doctoral Scientists and Engineers Employed in 4-Year Colleges and Universities: Percentage Who Are Women, by Rank and Field, 2003

	Rank			
Field	Full Prof.	Assoc. Prof.	Asst. Prof.	Instructor/Lecturer
Engineering	3.8	11.9	16.0	30.5
Physical sciences	6.8	19.2	24.5	27.6
Mathematics/statistics	9.2	15.9	29.2	41.8
Computer/info sciences	12.3	19.9	23.3	25.3
Life sciences	19.0	29.4	38.4	60.5
Social sciences	21.4	35.5	48.4	38.4

Source: Commission on Professionals in Science and Technology (2006), Table 4-50.

of minimum needs (Damanpour, 1991; Farr & Ford, 1990), and rewards and recognition for, and fair evaluation of, new ideas (Abbey & Dickson, 1983). The presence or absence of these conditions may enhance or block the translation of individuals' creativity into productive or innovative "products."

Likewise, in understanding the status of women in academic science, we need to consider features of the organizations in which people study and work (Fox, 1991, 1996, 1998, 1999, 2000, 2001, 2003, 2006, 2008; Fox & Mohapatra, 2007; Long & McGinnis, 1981; McIlwee & Robinson, 1992; Reskin, 1978; Smith-Doerr, 2004; Whittington & Smith-Doerr, 2008). Features of organizational settings are important to the attainments of women—and men—across fields. But they are especially important in scientific fields. This is because scientific work is fundamentally social and organizational. Scientific work is carried out "on site" with costly space and equipment, it is conducted in cooperation with students and others, it requires significant funding, and in short, it is an interdependent enterprise (Fox, 1991, 1992a).

Groups of people—including women compared with men—can have different experiences in these organizational environments, with implications for differences in significant participation and status. Drawing on recent survey data of women and men faculty in doctoral-granting departments in computer science, engineering, and science fields in nine highly ranked research universities, this article depicts four key social-organizational features of work as reported by women and men faculty: frequency of speaking with faculty about research in home unit, ratings of aspects of position and department, characterizations of departmental climates, and levels of interference experienced with work and family. These four features are key social-organizational indicators in a survey focusing on perceptions of and experiences with teaching and research, work environments, processes of evaluation, and household/work-family arrangements and addressing ways in which organizational factors shape outcomes of participation and performance in academic science and engineering. These four indicators are key social-organizational features of academic work for the following reasons.

Frequency of discussion with faculty about research is important because such discussion helps to generate and support research activity. Discussion about research helps spawn interests, test ideas, and reinforce research (Blau, 1973; Pelz & Andrews, 1976; Reskin, 1978). Through discussion, a scientist can evaluate problems, concepts, variables, and measures. Informal exchange also provides room for speculation, retraction, and the sharing of failures as well as successes. This provides immediate feedback and, in the process, helps establish the level of importance of the work (Fox, 1991).

Those outside of circles of communication, interaction, and exchange are denied important means of testing and developing ideas (Fox, 1991; Fox & Mohapatra, 2007). This is true for both genders. However, if women are more marginal to the social system of communication, as indicated by frequency of speaking about research, this has consequences for their level of significant participation and status and, potentially, rank.

Aspects of position and home unit are represented by respondents' reported assessments of critical areas related to teaching, research, and collegiality. The particular aspects, as described in this article, are teaching load, sense of inclusion, space available for research, and recognition and rewards received from faculty in their home unit. These aspects reflect experiences with human and material resources that are consequential to participation and status in academic science and engineering (Fox, 1991, 1992b, 2001; Fox & Colatrella, 2006). Experiences with human and material resources do not necessarily operate uniformly for people and groups in home units and may vary for women compared with men (Fox, 1991, 2001).

Reported *characterizations of home units* involve faculty's perceptions of their home units' climate and culture. Work climate involves meanings attached to salient features of organizational life (Moran & Volkwein, 1992) and perceptions about a unit's values, practices, and goals (Baird, 1990; Reichers & Schneider, 1990). Work climate is consequential because it can activate interests, convey standards, and stimulate or stifle performance (Blau, 1973; Kopelman, Brief, & Guzzo, 1990).

In this article, work climate is of interest because it encompasses aspects of the perceived atmosphere of an academic department along such dimensions as (less to more) "exciting" or "helpful." Responses on perceptions of such dimensions reflect, in turn, faculty members' characterizations of the "personality" of their units and the "way things are" in the department (Reichers & Schneider, 1990, p. 22), which may vary for women and men faculty. For most people familiar with higher education, departmental climate has "face validity"; it is regarded as a reasonable way to conceptualize perceived atmosphere of a unit (Peterson & Spencer, 1990, p. 8). Yet, "only the rare study addresses enabling climates and cultures for female academics" (Jordan & Bilimoria, 2007, p. 225).

Work-family interference is important insofar as work and family are "greedy" institutions that claim time, energy, and allegiance, drawing as much as they can in people's loyalty and absorption (Coser, 1974). Work and family/household can compete for limited resources of individuals, in ways that may be difficult to reconcile. Faculty in academic science and engineering are a strategic group for consideration of work and family/household interference because of particularly high demands in their work

time, workload, work commitment, and scheduled benchmarks for performance. The "perfect academic" is characterized as someone who "gives total priority to work and has no outside interests or responsibilities" (Bailyn, 2003, p. 139).

Work-family interference is potentially higher and more challenging for women, compared with men, because of physical, social, and psychological demands of pregnancy, childbirth, and childrearing and gendered expectations of family obligations and investments in household (Grant, Kennelly, & Ward, 2000; Hochschild, 1989; Ward & Wolf-Wendel, 2004). The assessment of work-family interference is important because it represents an appraisal of the extent to which demands in one sphere (work) affect, and potentially limit, participation in the other sphere (family) (Voydanoff, 2005). Thus, the reported levels of interference are consequential for understanding the nature of significant participation and status, by gender, in academic science and engineering.

The focus of this article is descriptive: It depicts women and men faculty's experiences in these four key social-organizational domains pertinent to scientific and academic institutional life. These descriptions are intended to enhance understanding of social-organizational indicators that both reflect and affect the conditions of women and men in academic science. The method of doing this is unusually comprehensive, based on a survey of the universe of tenured and tenure-track women (except for sampling in life sciences and psychology) and a stratified random sample of men, drawn from known (and specified) populations in nine research universities. Fundamentally, the patterns in the findings point to ways in which the participation, performance, and advancement of academic women and men are "organizational issues," subject to "organizational transformation" (Fox, 2008; Fox & Colatrella, 2006). Thus, the patterns described have implications for solutions sought for increased gender-equity in academic science and engineering.

Method

Data

The data reported here come from mail surveys conducted among tenured and tenure-track faculty in fields of computer science, engineering (across engineering fields), and sciences (chemistry, biology/life sciences, earth/atmospheric, mathematics, psychology, and physics). The faculty members are in nine research universities, represented by one baseline university that was surveyed in 2002/2003 and eight "peer institutions" surveyed in 2003/2004. The eight research institutions surveyed in 2003/2004 were those designated by the first institution surveyed as "peers" in prestigious, national standing. Thus, all the institutions have high national rankings, in particular within scientific and technological fields. These institutions do not represent the "universe" of U.S. institutions. Rather, they represent those with doctoral granting departments, strong standing in science/engineering fields, and relatively high levels of federally awarded research grants. In the study of science/engineering, this is an important grouping

of institutions because of the effect of institutions in this category for the training of doctoral students and the conduct of research.

In the first institution, the group surveyed is the population of women ($n = 68$) and a stratified random sample of men, by field ($n = 148$). In the eight other institutions, the group surveyed is the population of women, except for sampling in life sciences and psychology ($n = 437$), and a stratified random sample of men by field ($n = 528$). Of the 1,154 questionnaires sent in 2002-2004, 25 faculty members were ineligible owing to departure from the department, retirement, or being deceased. The number of respondents to the surveys was 765, with an overall response rate of 66.2% (removing ineligibles from the base). The response rates of faculty in engineering (67.4%) were slightly higher than those in computer science (64.5%) and sciences (65.5%). Women's response rate (67.8%) was slightly higher than men's (65.2%).

Variables in Profile of Reported Social-Organizational Features

Frequency of speaking about research is measured by faculty's response of the incidence of speaking about research projects and interests with faculty in their home units: *almost never*, *once or twice a semester*, *once or twice a month*, *at least once a week*, or *almost every day*. The responses to the question are recoded into three categories that represent the spheres of variation: speaking less than weekly, weekly, or daily.

Ratings of aspects of position and home unit involve respondents' reported assessments of 11 critical areas, including quality of faculty, students, space, equipment, and recognition received, as *poor*, *fair*, *good*, or *excellent* (on a 4-point scale). The aspects of position and home unit reported in this article are a subset representing social-organizational features of experience in home units through ratings in five areas: teaching load, sense of inclusion, space available for research, equipment available for research, and recognition of accomplishments received from faculty in one's home unit.

Characterizations of home units refer to respondents' reports of experienced and perceived aspects of their department's environment or climate. Climate is measured with questionnaire items with interval scales (1–5) along eight bipolar dimensions of (a) formal-informal, (b) boring-exciting, (c) unhelpful-helpful, (d) uncreative-creative, (e) unfair-fair, (f) noncompetitive-competitive, (g) stressful-unstressful, and (h) noninclusive-inclusive.

Work-family interference is measured by respondents' reports of the extent to which (a) "family and household responsibilities interfere with work" and (b) "work interferes with family and household responsibilities." The response categories are on a 4-point scale of *not at all*, *very little*, *somewhat*, or *a great deal*.

Analyses of Data

Figures 1 through 4 indicate where gender differences in the variables reach statistical significance based on *t* tests of differences between mean values for women and men or chi-square tests of differences in proportions of women's compared with men's

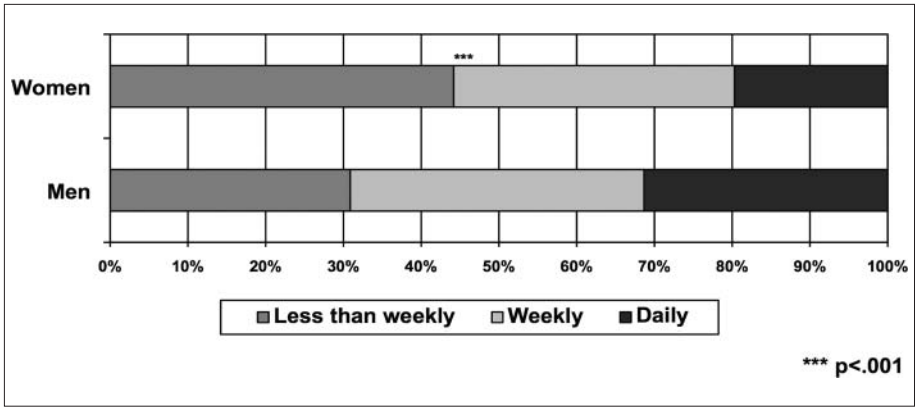

Figure 1. Frequency of speaking about research with faculty in home unit, by gender

responses among the particular categories of a given question. The probability levels noted in the figures are $p < .001$, $p < .01$, and $p < .05$.

Findings

In faculty's frequency of speaking about research with colleagues in home units, gender differences appear at the two extremes of frequency of speaking: 44% of women, compared with 31% of men, report speaking less than weekly, and 20% of women compared with 31% of men report speaking about research daily. The patterns of speaking weekly are similar, by gender: 36% of women and 38% of men reporting this incidence (see Figure 1). These patterns may reflect different pathways of ease and access of interaction in home departments of women compared with men faculty, as discussed in the conclusions.

A second area is ratings of aspects of positions within home units. These aspects are important because they represent ratings of experience with human and material resources in departments. Women report a significantly lower sense of inclusion in their home units. They also give significantly lower ratings of access to equipment. Furthermore, women report significantly lower recognition from faculty in home units (see Figure 2). Although the ratings of the various aspects of position and unit range around a level of close to "good" (3.0 on the scale), it is notable (a) that women give lower ratings for each of the aspects of position/unit and (b) that the gender disparity is significant for sense of inclusion, access to equipment, and recognition received from faculty.

Another feature of the work environment is the "character" or "climate" of home units, as perceived by faculty. Eight dimensions appear in Figure 3. In Figure 3, the level for one end of the dimension is on the left, and the level for the other end is on the right. Going from the top to the bottom in the bars appearing for the eight dimensions,

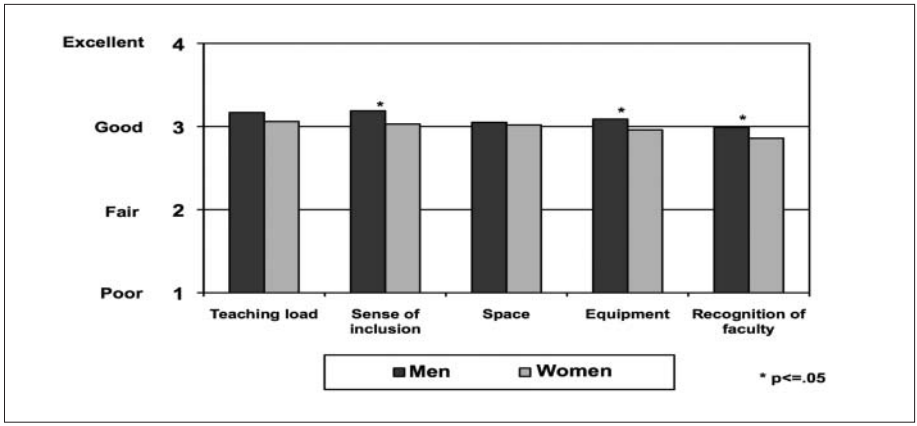

Figure 2. Rating of aspects of position/unit, by gender

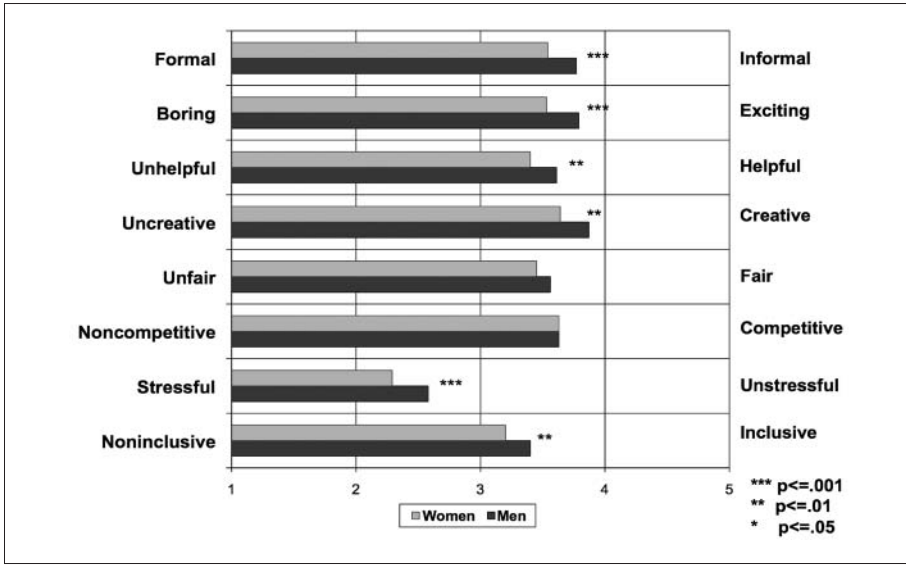

Figure 3. Characterizations of home department, by gender

we see that women are significantly less likely than men to characterize their home units as (a) informal (compared to formal); (b) exciting (compared to boring); (c) helpful (compared to unhelpful); (d) creative (compared to noncreative); and (e) inclusive (compared to noninclusive). Women are significantly more likely to characterize their units as stressful (compared to nonstressful). The two dimensions for which women and men give similar levels of characterization (that is, for which no significant gender

differences appear) are fairness (both women and men give ratings of near 3.5 on a 5-point scale) and, interestingly, competitiveness (both women and men give ratings of 3.63 on a 5-point scale).

Thus, what is notable is the pattern of significant gender differences in six out of the eight dimensions. The pattern is one of woman giving lower levels of characterization for positive dimensions (such as exciting) and higher ratings for negative dimensions (such as stressful).

A fourth area is reported interference between work and family/household. This is an important area because, as discussed in the introduction, work and family/household are greedy—and potentially competing—institutions, especially when scheduled benchmarks for performance make it difficult to take time off, temporarily.

Faculty members' reported interference goes in both directions: Work interferes with family/household, and family/household interferes with work. But the reported interference is higher for family/household on work than in the other direction. Furthermore, Men as well as women report interference. However, a gender difference exists in both directions of interference, and the gender difference is greater for the reported effect of family/household on work (than the other way around) (see Figure 4).

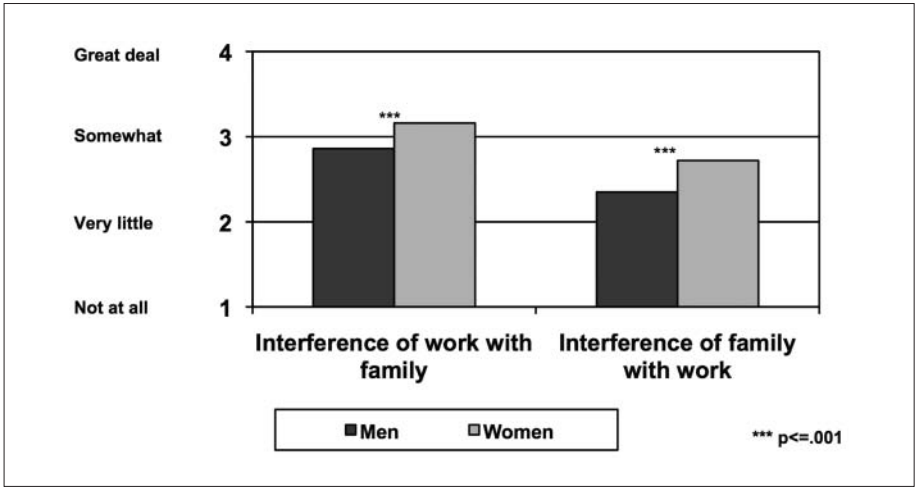

Figure 4. Reported extent of interference—work and family responsibilities, by gender

Conclusions

The faculty in this study hold tenured and tenure-track positions in prestigious research universities with high rankings in science and engineering fields. This is an important group because these women and men faculty are in institutions and departments that have a strong effect on the training of students and conduct of research. Those who hold such appointments are a selective group—in some sense, all U.S. academic

scientists and engineers live within the shadow and influence of these high ranking research institutions. However, within this selective group and in these influential settings, women and men report different perceptions and experiences with four key elements of their social-organizational environments.

First, women are less likely than men to report speaking daily about research and more likely than men to report speaking less than weekly. The higher percentages of men speaking daily about research with faculty in their home units may point to greater ease, access, and informality in their interaction and exchange—with consequences for testing ideas and updating research. The lower percentages of women who speak daily may also point to lower integration and sense of significant "membership" of women in the social milieu of the departments.

Second and related, women give significantly lower rankings to aspects of their position/unit, signifying lower benefits of human and material resources in vital areas: access to equipment, sense of inclusion from faculty in the department, and recognition received from faculty for their accomplishments. These are important because, as Jonathan Cole (1981) put it, women may be *in* science but not *of* the social community of science. More so than men, women may remain outside of the heated discussions, inner cadres, and social networks in which scientific ideas are aired, exchanged, and evaluated (Fox, 1991). Levels of exclusion limit not simply participation in a social circle but rather the capacity to participate significantly in the communities of science, to develop and test ideas, and to gain entrée into the informal culture of science (Fox, 1991).

Third, the characterizations that women, compared with men, give to their home units support the idea that academic environments do not necessarily operate uniformly, neutrally, or androgynously (Fox, 1991). Out of eight dimensions of departmental climate, women's characterizations are significantly lower than men's for the five positive aspects of departmental climates and significantly higher in the direction of a negative aspect of departmental climate (stressfulness).

Fourth, because work and family are both weighty and greedy (demanding) institutions, levels of work-family interference reported are notable. Reported interference goes in both directions—work interferes with family/household, and family/household interferes with work. However, faculty in science/engineering report higher levels of interference of work on family/household than of family/household on work. This may reflect normative expectations about the strong salience of scientific work as "a way of life." It may also reflect the institutional demands that work take priority over other domains. Furthermore, gender difference exists, with women reporting higher interference than men—especially of family on work. This may reflect the gendered expectations for women in household and families.

These data are notable because they point to patterns of responses, by gender, in these key social-organizational elements in academic science and engineering, revealed in a comprehensive and systematic survey of faculty in nine research universities. Such patterns have previously been the subject of speculation, but not based on firm and comprehensive findings. The data also have implications for solutions to support the significant and sustained participation and status of women, as well as men, in these fields. The opportunity for greater gender equity lies in addressing organizational

practices and policies that affect the patterns reported here. This may occur through means that include these.

First, departmental chairs can exercise leadership on patterns of speaking about research by taking steps to open communication and exchange among faculty members. The placement of junior faculty members in existing research networks and projects can affect opportunities in fields that are highly collaborative (Feldt, 1985, 1986). Furthermore, a case study of an academic science department that had achieved "cooperation, inclusion, and research productivity" (Jordan & Bilimoria, 2007) indicates ways that these three positive features (cooperation, inclusion, productivity) may be created through "constructive interactions," specifically. The interactions reported in the case study involve collegial exchange in formal and informal settings, opportunities for knowledge-sharing that allows faculty to learn about work and convey expected work norms and behaviors, relational interactions that build trust, and problem-solving interactions involving sharing of materials and expertise, funding for equipment, and support for writing proposals (Jordan & Bilimoria, 2007, pp. 230–231). The point for policy is that interaction, especially that involving research, is consequential for faculty, and such interaction may be organizationally created and sustained within departments.

Second, the distribution of resources, including those of start-up funds and patterns of release time, can be subject to equitable standards rather than being administrative favors bestowed or withheld (Fox, 2001). Policies for distribution of resources that are open and communicated can support equity and, potentially, satisfaction among faculty. At the same time, practices of equity may be expected to meet some resistance if they are seen as being at odds with excellence and with values of "academic competition." Thus, those undertaking initiatives for equity in distribution of resources need to be aware of the implicit beliefs about quality that may be challenged by new policies and practices with respect to start-up packages, for example (Fox, 2008, p. 98).

Third, departmental climates, and the differential ways in which they are experienced by people and groups, can be matters of attention as in NSF ADVANCE initiatives' workshops with small groups of departmental chairs to increase awareness of departmental climates, identify issues of concern, and address them (Fox, 2008). (The NSF ADVANCE initiatives are based on awards made by the National Science Foundation to "increase the representation and advancement of women in academic science and engineering careers.") In addition, grants or awards can be provided to departments with proposals to transform climates and cultures toward improved equity, inclusion, and advancement of faculty, as has occurred with NSF ADVANCE initiatives (Fox, 2008, p. 92).

Fourth, work-family conflicts are amenable to initiatives establishing on-campus daycare, leaves for birth, adoption, or illness of children and other family members, and dual-career hiring programs. Work-family/household conflicts may be addressed by initiatives such as the ADVANCE "life transition" awards that make grants to outstanding faculty members who are in the midst of major life transitions, such as personal medical needs, family illness, or caring for elderly parents. The grants, which may be used for release time, research assistance, or other expenses, are designed to "help faculty as they deal with the stress and challenges of balancing an academic career with personal life" (Riskin, Lange, Quinn, Yen, & Brainard, 2007, p. 118). Such

life transition awards have supported the productivity of faculty during times of personal challenges and, in the process, demonstrated the investment of the institution in the success of its academic personnel.

The opportunity, then, is that just as social-organizational environments are structured, so they can continue to be restructured—to support enhanced and gender-equitable participation of faculty in science and engineering. This involves ongoing examination and attention to the ways in which the organization and climates of departments and the distribution of human and material resources can support equity toward full and significant participation and status in science and engineering.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

Funding

The author disclosed receipt of the following financial support for the research and/or authorship of this article:

The research reported here was supported in part by a grant from the National Science Foundation (SBE 0123532).

References

Abbey, A., & Dickson, J. W. (1983). R&D work climate and innovation in semiconductors. *Academy of Management Journal*, *26*, 362-368.

Amabile, T. M. (1988). A model of creativity and innovation in organizations. In B. M. Staw & L. L. Cummings (Eds.), *Research in organizational behavior*, *Vol. 10* (pp. 123-167). Greenwich, CT: JAI.

Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron, M. (1996). Assessing the work environment for creativity. *Academy of Management Journal*, *39*, 1154-1183.

Andrews, F. M. (1976). Creative process. In D. C. Pelz & F. M. Andrews (Eds.), *Scientists in organizations: Productive climates for research and development* (pp. 337-365). Ann Arbor, MI: Institute for Social Research.

Astin, H., & Sax, L. (1996). Developing scientific talent in undergraduate women. In C. S. Davis, A. Ginorio, C. Hollenshead, B. Lazarus, & P. Rayman (Eds.), *The equity equation: Fostering the advancement of women in the sciences, mathematics, and engineering* (pp. 96-121). San Francisco: Jossey-Bass.

Bailyn, L. (2003). Academic careers and gender equity: Lessons learned from MIT. *Gender, Work, and Organizations*, *10*, 137-153.

Baird, L. L. (1990). Campus climate: Using surveys for policy-making and understanding. In W. Tierney (Ed.), *Assessing academic climates and cultures* (pp. 35-45). San Francisco: Jossey-Bass.

Blau, P. (1973). *The organization of academic work*. New York: John Wiley.

Boardman, C., & Bozeman, B. (2007). Role strain in university research centers. *The Journal of Higher Education*, *78*, 430-463.

Cole, J. (1981). Women in science. *American Scientist*, *69*, 385-391.

Cole, J., & Cole, S. (1973). *Social stratification in science*. Chicago: University of Chicago Press.

Commission on Professionals in Science and Technology. (2006). *Professional women and minorities: A total human resource data compendium* (16th ed.). Washington, DC: Author.

Corley, E., & Gaughan, M. (2005). Scientists' participation in university research centers: What are the gender differences? *Journal of Technology Transfer*, *30*, 371-381.

Coser, L. A. (1974). *Greedy institutions: Patterns of undivided commitment*. New York: Free Press.

Damanpour, F. (1991). Organizational innovation: A meta-analysis of determinants and moderators. *Signs: Journal of Women in Culture and Society*, *24*, 201-223.

Farr, J. L., & Ford, C. M. (1990). Individual innovation. In M. A. West & J. L. Farr (Eds.), *Innovation and creativity at work* (pp. 63-80). Chichester, UK: Wiley.

Feldt, B. (1985). *An analysis of productivity of nontenured faculty women in the medical school and a related school*. Ann Arbor: The University of Michigan, Office of Affirmative Action.

Feldt, B. (1986). *The faculty cohort study: School of Medicine*. Ann Arbor: The University of Michigan, Office of Affirmative Action.

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

Fox, M. F. (1992a). Research productivity and the environmental context. In T. G. Whiston & R. L. Geiger (Eds.), *Research and higher education: The United Kingdom and the United States* (pp. 103-111). Buckingham, UK: The Society for Research into Higher Education & Open University Press.

Fox, M. F. (1992b). Research, teaching, and publication productivity: Mutuality versus competition in academia. *Sociology of Education*, *65*, 293-305.

Fox, M. F. (1996). Women, academia, and careers in science and engineering. In C. S. Davis, A. Ginorio, C. Hollenshead, B. Lazarus, & P. Rayman (Eds.), *The equity equation: Fostering the advancement of women in science, mathematics, and engineering* (pp. 265-289). San Francisco: Jossey-Bass.

Fox, M. F. (1998). Women in science and engineering: Theory, practice, and policy in programs. *Signs: Journal of Women in Culture and Society*, *24*, 201-223.

Fox, M. F. (1999). Gender, hierarchy, and science. In J. S. Chafetz (Ed.), *Handbook of the sociology of higher education* (pp. 441-457). New York: Kluwer Academic/Plenum Publishers.

Fox, M. F. (2000). Organizational environments and doctoral degrees awarded to women in science and engineering departments. *Women's Studies Quarterly*, *28*, 47-61.

Fox, M. F. (2001). Women, science, and academia: Graduate education and careers. *Gender & Society*, *15*, 654-666.

Fox, M. F. (2003). Gender, faculty, and doctoral education in science and engineering. In L. Hornig (Ed.), *Equal rites, unequal outcomes: Women in American research universities* (pp. 91-109). New York: Kluwer Academic/Plenum Publishers.

Fox, M. F. (2006). Women and academic science: Gender, status, and careers. In C. Marzabadi, V. Kuck, S. Nolan, and J. Buckner (Eds.), *Are Women Achieving Equity in Chemistry? Dissolving Disparity, Catalyzing Change* (pp. 17-28). New York: Oxford University Press.

Fox, M. F. (2008). Institutional transformation and the advancement of women faculty: The case of academic science and engineering. In J. C. Smart (Ed.), *Higher education: Handbook of theory and research* (pp. 73-103). New York: Springer.

Fox, M. F., & Colatrella, C. (2006). Participation, performance, and advancement of women in academic science and engineering: What is at issue and why. *Journal of Technology Transfer*, *31*, 377-386.

Fox, M. F., & Mohapatra, S. (2007). Social-organizational characteristics of work and publication productivity among academic scientists in doctoral-granting departments. *The Journal of Higher Education*, *78*, 542-571.

Glynn, M. A. (1996). Innovative genius: A framework for relating individual and organizational intelligences to innovation. *The Academy of Management Review*, *21*, 1081-1111.

Grant, L., Kennelly, I., & Ward, K. (2000). Revisiting the gender, marriage, and productivity puzzle in scientific careers. *Women's Studies Quarterly*, *28*, 62-83.

Hanson, S. (1996). *Lost talent: Women in the sciences*. Philadelphia: Temple University Press.

Hochschild, A. (1989). *The second shift: Working parents and the revolution in the home*. New York: Viking Press.

Jordan, C. G., & Bilimoria, D. (2007). Creating a productive and inclusive work environment. In A. J. Stewart, J. E. Malley, & D. LaVaque-Manty (Eds.), *Transforming science and engineering: Advancing academic women* (pp. 225-242). Ann Arbor: The University of Michigan Press.

Kopelman, R., Brief, A., & Guzzo, R. (1990). The role of climate and culture in productivity. In B. Schneider (Ed.), *Organizational climate and culture* (pp. 282-318). San Francisco: Jossey-Bass.

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

Long, J. S., & Fox, M. F. (1995). Scientific careers: Universalism and particularism. *Annual Review of Sociology*, *21*, 45-71.

Long, J. S., & McGinnis, R. (1981). Organizational context and scientific productivity. *American Sociological Review*, *46*, 422-442.

McIlwee, J., & Robinson, G. (1992). *Women in engineering*. Albany: State University of New York Press.

Merton, R. K. (1973). The normative structure of science. In N. Storer (Ed.), *The sociology of science* (pp. 267-278). Chicago: University of Chicago Press. (Original work published 1942)

Moran, E. T., & Volkwein, J. F. (1992). The cultural approach to the formation of organizational climate. *Human Relations*, *45*, 19-47.

Pearson, W., & Fechter, A. (Eds.). (1994). *Who will do science? Educating the next generation*. Baltimore: Johns Hopkins University Press.

Pelz, D., & Andrews, F. M. (1976). *Scientists in organizations: Productive climates for research and development*. Ann Arbor, MI: The Institute for Social Research.

Peterson, M., & Spencer, M. (1990). Understanding academic culture and climate. In W. Tierney (Ed.), *Assessing academic culture and climates* (pp. 3-18). San Francisco: Jossey-Bass.

Reichers, A. E., & Schneider, B. (1990). Climate and culture: An evolution of the constructs. In B. Schneider (Ed.), *Organizational climate and culture* (pp. 5-39). San Francisco: Jossey-Bass.

Reskin, B. (1978). Sex differentiation and the social organization of science. *Sociological Inquiry*, *48*, 6–37.

Riskin, E., Lange, S. E., Quinn, K., Yen, J., & Brainard, S. (2007). Supporting faculty during life transitions. In A. J. Stewart, J. E. Malley, & D. LaVaque-Manty (Eds.), *Transforming science and engineering: Advancing academic women* (pp. 116-130). Ann Arbor: The University of Michigan Press.

Smith-Doerr, L. (2004). *Women's work: Gender equality vs. hierarchy in the life sciences*. Boulder, CO: Lynne Rienner.

Sonnert, G., Fox, M. F., & Adkins, K. (2007). Undergraduate women in science and engineering: Effects of faculty, fields, and institutions over time. *Social Science Quarterly*, *88*, 1333-1356.

Sonnert, G., & Holton, G. (1995). *Gender differences in science careers*. New Brunswick, NJ: Rutgers University Press.

Stake, J. E., & Noonan, M. (1983). The influence of teacher models on the career confidence and motivation of college students. *Sex Roles*, *12*, 1023-1031.

Voydanoff, P. (2005). Work demands and work-to-family and family-to-work conflict. *Journal of Family Issues*, *26*, 707-726.

Ward, K., & Wolf-Wendel, L. (2004). Academic motherhood: Managing complex roles in research universities. *The Review of Higher Education*, *27*, 233-257.

Whittington, K. B., & Smith-Doerr, K. (2008). Women inventors in context. *Gender & Society*, *22*, 194-218.

Xie, Y., & Shauman, K. (1997). Modeling the sex-typing of occupational choice. *Sociological Methods and Research*, *23*, 233-261.

Xie, Y, & Shauman, K. (2003). *Women in Science: Career Processes and Outcomes.* Cambridge, Mass.: Harvard University Press.

Zuckerman, H., Cole, J., & Bruer, J. (1991). *The outer circle: Women in the scientific community*. New York: W. W. Norton.

Bio

Mary Frank Fox is an advance professor in the School of Public Policy and co-director of the Center for the Study of Women, Science, and Technology at Georgia Institute of Technology. Her research focuses on gender and scientific organizations and occupations. Her publications appear in more than 50 different scholarly and scientific journals, books, and collections. Her current projects include a study of programs for undergraduate women in science and engineering, supported by NSF; the research program of Georgia Tech's NSF ADVANCE institutional transformation award, for which she was co-PI; and a study of faculty careers in computing, supported by NSF through the Georgia Tech Hub of the National Center for Women and Information Technology and by the Kauffman Foundation.