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Chapter Two

The Current Status of Women in Research Universities

Lilli S. Hornig

In this chapter we establish a baseline of the position of women faculty at the turn of the millennium, a mark against which future change can be measured. To set this in its proper context we also look back, to the extent possible, at the situation in 1970, just as efforts to increase the participation of women began. It is not only the proportion of women that is of interest, but also their varying distribution among institutions and departments, whether the conditions of their work settings and environments are supportive or constraining, and how these factors have changed in the last three decades.

No very clear starting point for such an analysis exists. Data on women faculty were not of general interest before 1970, when approximately 23 percent of faculty across all postsecondary institutions were women (Vetter and Babco 1997:151), and no database on this topic exists for the research universities. Reliable data on women's distribution across fields and departments are also scarce or nonexistent. However, a number of reports from leading universities concerning the status of women were compiled around 1970, in response to the impending requirement for affirmative action plans, by newly appointed *ad hoc* or sometimes statutory committees on the status of women. These reports were to serve as the basis for calculating "goals"—the number of women or minorities that would have to be added to academic units in order to match their availability—and "timetables" for attaining the specified goals. Note that

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universities were expected to recruit women or minorities only at the levels of competence that were traditional for each institution, not to lower their standards in any way, and that the timetables were flexible.

DATA SOURCES

The American Association of University Professors (AAUP) publishes an annual report on the economic status of the profession which also reports on numbers and proportions of women, and their salary differences from men, at each regular academic rank in over 1800 universities and colleges. These data serve as our source of the proportions of women faculty at the three regular ranks (although instructors are also included in the tabulations). Although the published tables also include the proportion of each rank that is tenured, this unfortunately does not yield unequivocal data by gender, and a summary table (*Academe*, March-April 2000:20) does not separate data on tenure for research universities only. We include data for 2000 and comparisons with 1988 and 1998 figures to gauge the rate of change. In an effort to also understand better the distribution of women across departments, we asked the affirmative action officers at the RU I institutions to send us their most recent affirmative action reports, assuming that these would be using a fairly standard format and thus be at least roughly comparable across the institutions. This approach was only partially successful. Only 40 of the 88 universities responded by sending the reports, which are public documents, and they used many different formats. Although we were able to sort out some information about departmental or divisional distributions, these were often not comparable among universities because of differing organization.

To gain a better understanding of the general climates and attitudes toward the recruitment, retention, and promotion of women in various universities, we also sent a letter survey to the chief academic officers of the 88 institutions. The questions we asked were the following:

1. What steps has your institution taken to insure that no gender bias enters into recruitment, appointment, promotion, and tenure decisions? Do you feel they have been successful? If not, where have they failed?
2. What, if any, incentives exist for departments to increase the numbers of women faculty? Are set-aside funds available to take advantage of targets of opportunity in recruitment and hiring? Do you feel that such strategies have been effective?

3. If the numbers of women faculty at your institution remain relatively small, to what do you ascribe this problem?
4. Does your institution facilitate access to daycare? Do you encourage the hiring/tenuring of couples? Are there other "family-friendly" policies in place, such as provision for extending probationary periods for young parents, or for assistance with caring for ill or elderly family members?
5. Which of the initiatives you have taken do you consider most successful? Which least?
6. If increasing the proportions of women faculty is a priority at your institution, how is this conveyed to departments? What mechanisms exist for insuring that the policies are carried out?
7. Is there a standing committee on women faculty in your institution? What is its charge, and how often does it report?

After one reminder mailing, answers to this set of questions were received from only 20 universities, about 23 percent of the total. It is probably fair to assume that non-responding institutions had relatively low interest in these issues.

RESULTS

A. PROPORTIONS OF WOMEN FACULTY

A sampling of reports on the status of women produced in the early 1970s, while in no way comprehensive, does serve as an indication of the low starting point from which we can assess changes over the last three decades. The institutions mentioned here are representative of the top research universities at that period as well as currently.

In 1971 the AAUP Committee on the Status of Women (Indiana 1971:8) studied the position of women at Indiana University, Bloomington Campus, and reported a total of 5.2 percent women full professors, 8.8 percent associate professors, 14.3 percent assistant professors, and 26.3 percent instructors, for an overall total of 10.6 percent. Out of 43 schools and divisions, 16 had no women at any level (*Ibid.*, Table 2).

Also in 1971, a report from the Committee on the Status of Professional Women at Yale (Yale 1971) found that women were 0.5 percent of full professors, 1.3 percent of associate professors, and 8.2 percent of assistant professors; including the 12.5 percent of instructors, the total faculty of 469 had 19 women, or 4 percent. The departments of chemistry, political science, and sociology had no women at any rank.

A 1972 report from UCLA (Chancellor's Advisory Committee 1972:3) found that women made up a total of 7 percent of all faculty in what was termed the Regular Professorial Series, and only 4.5 percent of full professors. The authors pointed out that these proportions exaggerate the representation of women overall because only four departments (Nursing, Dance, Public Health, and Physical Education) accounted for one-third of all women faculty. They further investigated the historical record at UCLA, finding that in 1940-41 women had been 12 percent of the regular faculty. Ten years later they were 13 percent of full professors, 10 percent of associate professors, and 12 percent of all tenured faculty, contrasted with 5 percent in 1972.

The University of California (UC 1972) studied the position of women faculty at three of its graduate campuses—Berkeley, Los Angeles, and Davis. At Berkeley the study found 48 women, 4 percent of 1,214 regular faculty at the rank of instructor or higher (p.10). Two years after the previous study, UCLA had a total of 11 percent women faculty including both regular ranks and instructors, lecturers and associates. UC-Davis counted 88 women, 8 percent of the total including the 45 who were lecturers. The remaining 43 comprised 2.5 percent of professors, 6.6 percent of associate professors, and 7.4 percent of assistant professors.

The Task Force on Women of the University of Tennessee reported to the Chancellor (U-TN 1972:72) that women were 8.2 percent of professors, 9.6 percent of associate professors, 21.7 percent of assistant professors, and 52.2 percent of instructors. Women were 13.6 percent of the total at the three upper ranks.

Cornell's *ad hoc* Trustee Committee on the Status of Women (Cornell 1974:4) reported that there were 110 women out of a total 1,474 persons at the three professorial ranks, or 7.5 percent, but that one half of these women were in the College of Human Ecology. In descending rank order, women were 3 percent, 10.5 percent, and 12 percent of the three ranks.

A somewhat later study from the University of Minnesota (U-MN 1978:5) prepared while the university was being sued for sex discrimination—a suit which eventually cost them a reputed $10 million—listed a total of 13.5 percent women at the three professorial ranks in 1977, a reduction from the 15.4 percent that had been present in 1951. The College of Technology had only 1.6 percent women in 1977.

All of these universities, and all other RU Is, have changed markedly since then, as the data in Table 1 demonstrate. However, the changes have been uneven in several ways. By 1988 all but three of the universities

(CalTech, Georgia Tech, and MIT) had 10 percent or more total women faculty, and by 2000 the great majority were well above 20 percent. The range of these figures was considerable, from 4.1 percent to over 28 percent in 1988 and from 10.7 percent to 34.3 percent in 2000, with CalTech and Virginia Commonwealth University being the low and high extremes, respectively, in both years. Some institutions showed growth spurts in one time interval but lagged in another, probably reflecting such factors as age distributions of faculty or expansion in some fields. Overall the regular faculties did not grow much, and shrank in some universities, a symptom of steady-state policies and the ever-increasing use of temporary, part-time, and adjunct faculty. Comparing the results for 2000 with the reports of the '70s gives us a rough idea of the rates of increase over almost thirty years, and the results are not very impressive. The annual increases amount to about 0.5 percentage points in most of these institutions over the entire period.

Table 1 also includes the average annual growth (or loss) in the proportion of women for the two intervals, 1988-98 and 1998-2000. Again, the results are widely scattered, from a low of zero at the University of Alabama to 1.53 points at the University of New Mexico in the first interval, and from -4.7 at Yale to 6.45 at Ohio State in the second. The average proportion of women has grown by over 60 percent in twelve years, and the average annual increase is 0.6 to 0.7 percentage points.

The rank distributions of women and men faculty, also obtainable from the AAUP tables and detailed in Table 2, paint a more complex picture. The ranks of full professors in 1988 are sparsely populated by women, with fewer than one-fifth of the institutions exceeding 10 percent; they average 7.9 percent. At the associate professor rank women held about one fifth of positions, on average, and they were almost one third of assistant professors. Note, however, that the range of these proportions is again considerable: in 1988 CalTech had only 1.2 percent women full professors while at the other extreme New York University had 15.9 percent. By 2000 women's share of full professorships had nearly doubled, to an average of 14.4 percent, associate professorships increased by 50 percent, and assistant professorships by 29 percent. Again, there was a wide spread, from a low of 5.7 percent women full professors at Georgia Tech to a high of 23.1 percent at Georgetown. Similarly, women associate professors were 15.8 percent at Georgia Tech and 43.4 percent at Johns Hopkins, while for assistant professors the range was from 23.9 percent, again at Georgia Tech, to 57.8 percent at

Virginia Commonwealth University. It is still the case that most of the men are full professors while the majority of women remain assistant professors.

Tenure

The information supplied in affirmative action reports often includes tenure status only as consolidated figures for tenure and tenure-track personnel. These do not furnish much insight for two reasons: 1) we do not know how they break down between tenure and tenure-track, and 2) perhaps more significantly, some top private institutions do not have a tenure track in the sense it is understood in public systems. In the latter, there are usually well defined criteria for promotion to tenure after a set probationary period; it is generally assumed that a tenure review will end favorably, absent any explicit failures to meet expectations. In many other universities, however, the practice is to search nationally or internationally for the best possible person who can be recruited, a search in which existing junior faculty may also be candidates. In the past this resulted only occasionally in granting tenure to junior faculty already in place, although in recent years these institutions have generally relaxed this rule, primarily because they found that lacking the expectation of tenure, many outstanding people chose to seek junior appointments elsewhere. Both Harvard and Yale have recently been promoting junior faculty at much higher rates than in the past.

Due in large part to the great diversity among universities even in this relatively small segment, we were unable to extract any meaningful national data on tenure from the affirmative action reports. This is the case because there are great differences in size, mission, and types of units or divisions among institutions. For example, flagship state universities and other land grant campuses usually have schools of nursing, home economics, library science, and education, all heavily skewed toward women, and schools of engineering, technology, agriculture, and other traditionally male-dominated fields. Such divisions may be absent or very small in other universities, and in any case the balance among them may fluctuate widely. It should be noted that equal-opportunity regulations take account of this diversity by allowing each institution to work out its own goals and timetables and assess its own performance, subject to federal review.

A few illustrative examples from affirmative action reports will serve to show the range of data presented. UC-Berkeley, for instance, reported in 1997 on a retrospective look at its women faculty, finding that the

proportion of tenured posts held by women had grown from 4.9 percent in 1976 to 20.2 percent in 1997, while the proportion of "ladder" posts went from 22.4 percent to 38.4 percent. In another summary Cornell reported an increase in new tenure appointments of women from 14.1 percent (1993) to 16.0 percent (1997). At MIT the tenure fraction rose from 9.7 percent in 1996 to 11.2 percent in 1997. Between 1990 and 1995 at the University of Illinois (Chicago) women's share increased from 18.6 percent to 22.7 percent of combined tenured and tenure-track positions in the college of arts and sciences, and from 35.1 percent to 46.5 percent in the college of education. At the University of Massachusetts (Amherst) from 1992 to 1996 the increase for women in combined tenure and tenure-track appointments was from 21.3 to 23.6 percent.

Table 3 shows the breakdowns for tenure, tenure-track, and off-track positions for women, to the extent they could be identified from the affirmative action reports we received. Note that the figures are for three different years and are grouped accordingly.

Field Distributions

An issue of considerable interest is how the actual proportions of women faculty in various fields are related to their presence in the appropriate doctoral pool, i.e. in that pool as it existed in a relevant time period. For example, reaching full professor status is generally taken to require ten to twelve years post-Ph.D. whereas assistant professors are drawn from a recent Ph.D. pool; "recent" differs from one field to another, depending on the need for one or more years of postdoctoral fellowship experience. So-called "availability" estimates are based on the Doctoral Records File of the National Academy of Sciences; academic departments are expected to use these data to determine what the expected availability of female or minority candidates is for a given position. Some of the affirmative action reports we examined contain comparisons of actual hiring with availabilty. Representative examples are listed in Table 4. There is no single case where the actual proportions of female faculty even approach the institutions' own availability figures. As Duke University's report for 1996 (p. 17) states, "University hiring has lagged behind availability of women in the workforce for years; as availability continues to increase each year, this trend has continued." The differences between actual proportions and availability are very large in chemistry and math, somewhat less so in biology and social sciences, and smallest in English. The discrepancy in

chemistry has persisted nearly unchanged since the 1970s; chemistry is much the largest field in the physical sciences for women, annually producing about as many women Ph.D.s as English and currently amounting to over 30 percent of new doctorates.

Salaries

Salary differences between male and faculty have existed for many years, as they have in other professions (Ahern and Scott 1981:76; NAS 1983:4.21; Hornig and Ekstrom 1984:188). That situation remains unchanged, although the differences have declined somewhat. Faculty women's salaries by rank, as a percentage of men's, are listed in Table 5. Out of over 770 cases included there (three ranks for each institution for each of three different years) there are six instances of equal salaries: full professors at Georgetown in 1988, associate professors at Stanford in 1988, Georgetown in 1998, and Berkeley in 2000, and assistant professors at Cornell (statutory colleges) in 1988 and CalTech in 2000. Note that there are also four cases of women having higher salaries than men, at Georgetown for associate professors in 1988, at Duke in 1988 and Oregon State in 2000 for full professors, and at Temple in 2000 for assistant professors.

B. SURVEY QUESTIONS

As noted above, the seven questions we asked in letters addressed to presidents and chancellors received replies from fewer than one quarter of the universities, with answers ranging from perfunctory to comprehensive and thoughtful. Perhaps significantly, in view of its subsequent admission of problems concerning the treatment of senior women faculty (see Introduction, this volume), MIT responded with the simple statement that "faculty are asked to recognize and avoid gender bias," surely the zenith of faith in faculty judgment in this area. Most universities were less sanguine, however. A perceptive observer at the University of Washington wrote, "It is not possible to insure that no bias enters into the employment process."

That may indeed be the case, but many institutions are trying in many ways to minimize the possibility. There is general agreement that effective steps can be taken to foster fairness in faculty employment decisions. The following are steps that the responding institutions generally agreed on:

1. Frequent updating and dissemination to departments of availability data on women scholars in their respective fields;

2. Continuous monitoring of search design and execution;
3. Monitoring of results, continuous evaluation of whether goals are met, and feedback to departments;
4. Insuring inclusion of women on all search and promotion committees; if none are available in the department or institution they are recruited from outside;
5. Where external referees are customary, they must include women;
6. Accountability for results is essential; success or failure in meeting established goals must be considered in performance reviews;
7. Integration of diversity goals into institutional planning processes and line decision-making; and
8. Responding universities emphasize that the most important ingredient is *effective high level leadership* to set clear expectations for bias-free recruitment and promotion.

Among explicit policies that foster recruitment and retention of women, provisions for extending the tenure clock and for family leave are widespread, although several institutions noted that they were used less than expected and speculated that some disadvantage was believed attached to their use. A widely favored tool for fostering faculty diversity is a "target of opportunity" program by which special funds are set aside for recruiting outstanding women or minorities who might become available even though no regular faculty line is open. University of California campuses that had such programs in the past regretted having had to end them, in accord with new state law. The University of Washington's program is noteworthy for its flexibility and comprehensiveness. It is not limited to women and minorities. It provides funding in anticipation of a later vacancy (as do several other programs), for summer or other special support needs, to meet competitive offers to existing faculty, and to help with placement of partners. The institutions that have such programs in place uniformly regard them as highly successful tools. A few mentioned having had to end them due to budgetary constraints, and several also noted that they were used more often for minorities than for women.

Most of the responding universities are concerned about the placement problem for spouses or partners, especially if they have failed to recruit a faculty member they wanted who came with an academic partner, or have lost a star whose spouse could not be accommodated. Most of the institutions that singled out this issue are in locations without other suitable universities that might broaden the possibilities. Accommodations

include use of bridge funds until line positions become available, help with placement elsewhere, counselling, and some moral support and general encouragement.

DISCUSSION

What do all the numbers mean, and how do they relate to the answers to the survey questions? First, we note that there seemed to be no particular correlation between response rates to our requests for information and "good" or "bad" statistics. Judging by brief notes attached to reports sent to us, the differences mostly had to do with whether a particular affirmative action officer or a president or provost was interested in the issues. Beyond that, what is striking about the results is that despite the many differences in the universities represented—differences in mission, structure, fields included, size, population base, and location—the figures overall show remarkable consistency. This fact suggests, but certainly does not prove, that the problems of simply gaining access for women are no longer primarily structural. The increases in the total proportion of women faculty have slowed: although the average annual percentage point gain remains essentially constant, this means, of course, that the *rate* of increase is declining steadily, from about 4 percent per year around 1990 to about half that by 2000. Note, however, that this represents a characteristic growth curve, rapid near the beginning and slowing as it approaches an end point. In any case, individual institutions vary enormously in this respect; many that were slow to begin adding women faculty made up the difference later, and many that had larger proportions at the start either slowed the pace later or even reversed it quite drastically, like Yale and Georgetown.

The net effects of these changes become evident in Table 2, where we find that between 1988 and 2000 the proportion of women full professors has almost doubled, on average, while that of assistant professors is up nearly one-third, and now matches quite precisely the fraction of new women doctorates in the mid-'90s, about 40 percent. Since the 1970s the gains are quite encouraging. Again, variations among institutions are very large, however. Individual universities need to review their own figures to determine not just how well or badly they are doing compared to the average, but where within their system major departures from the norm are occurring.

Tenure status may be one of the factors to examine. The proportion of women with tenure continues to lag a long way behind men; at one

institution after another, many more men hold full professorships than other ranks, while most of the female faculty are assistant professors. In part, of course, that is a result of women's relatively late entry into the field, although there is also plentiful evidence that women are promoted more slowly. A few of these universities acknowledge this problem in their reports. (See Chapter Six for an extended analysis.)

Another factor that emerges is departmental distributions compared to availability (Table 4). In the humanities, especially in languages and literature, women remain underrepresented, generally comprising about one-half of the available pool. The comparison is slightly better in social sciences, but very much worse in natural and especially physical sciences and math, where only about one-third of available women are appointed. Since very few women hold full professorships in the latter fields it is likely that the situation is actually worse than the numbers suggest, because there have been more hiring opportunities in the sciences than in the humanities, and the proportion of women in the pool of recent doctorates is well above that in the overall pool. The suggestion that emerges is that far from breaking down outmoded stereotypes, universities are actually reinforcing them in their faculties. By not having representative numbers of women science faculty, they support the increasingly false perception that women aren't scientists—surely not the message they want consciously to transmit to their students.

Another message implicit in the numbers is that women students are in a sense not getting the same education as men. The ratio of male students to male faculty varies from about 4:1 in the Ivy League to about 12:1 in large public universities; for women the corresponding figures are 11:1 and 40:1. Tens of thousands of women graduate each year without ever having had a woman professor, and that has ramifications for mentoring, role models, and messages conveyed about the suitability of academic careers for women. If the gender ratios were reversed, would it be acceptable?

Despite their apparent precision, the data on salaries are somewhat ambiguous. Confounding factors include field distributions, since salaries in the sciences are generally higher and there are proportionately fewer women in these fields, and age in rank, because at each rank women as a group are the more recent entrants and therefore paid less, legitimately. However, the most striking fact about salaries is that on average the differential between men and women has remained essentially unchanged for more than a decade. In fact, it has remained that way for over half

a century (Ahern and Scott 1981:82). Except for one four-year interval, 1970-74, these authors consistently found the largest salary differences in chemistry, with biological sciences next highest. The rank with the largest inequity remains full professor, and the difference that is hardest to explain away is at the entry level, assistant professor, where one must assume that appointees have very similar qualifications. This is an area that institutions should review very carefully. Salary inequities are not merely a current disadvantage to women; perhaps their most deleterious effect shows up at retirement. Salary issues are treated in greater detail by Long (this volume).

A broad-gauge overview of the situation suggests strongly that this growth in numbers would not have taken place without the impetus provided by the civil rights laws. However, the fact that change at higher ranks has been disappointing, and the essentially unchanging salary differentials, also corroborate what is known about lack of enforcement of the regulations beyond the entry level (see Introduction, this volume). However, it is not at all clear that more stringent enforcement is the best answer to creating an academic environment that is more supportive of achievement by women. Enforcement efforts generate opposition which is likely to exacerbate existing problems rather than solve them. Rather, the responses to our questions as well as the public acknowledgment by MIT and some of its sister institutions of not having treated senior women faculty equitably argue strongly for a more individualized, intra-institutional approach. The factors involved in the differential treatment of women faculty are very hard to quantify, and again vary not just from one university to another but also from department to department and over time. They are probably most damaging in the sciences, where problems such as research funding, facilities, and space assignments are likely to affect both satisfaction and productivity. An exemplary approach to dealing with these issues is described by Fried (this volume).

Central to such an approach is the fact that the process of undertaking it itself sensitizes faculty and administrators to the "climate" issues that contribute to women's disadvantage. These include matters such as scheduling meetings at times convenient to all participants, inclusion of women in faculty decision-making, informal as well as formal, and better information flow. In particular, the process must include careful review of how colleagues evaluate women candidates for appointments and promotions. In fields where it is possible to have anonymous reviews, i.e. where the track record does not necessarily identify an individual, these should be required. Such practices have been the norm in Modern Language

Association publications for many years, and were found to improve acceptance of women's works markedly. Valian (1998, Ch. 7) offers an extended discussion of the many factors that differentiate evaluations of women's scholarly work from men's and downgrade women's achievements simply because they are women. An interesting statistical corroboration of this effect comes from data on science and engineering faculty disaggregated by institutional type. Among a total of almost 300,000 faculty members, 29 percent of the men are in a research university, but that opportunity comes to only 17 percent of similarly qualified women (Vetter and Babco 1997:154). To insure continued growth in opportunities and equality for women faculty, universities will have to develop ways to cope with deep-rooted prejudices.

TABLES

Table 1

PERCENT WOMEN TOTAL FACULTY, RESEARCH I UNIVERSITIES, 1988, 1998, and 2000

(Nonmedical instructional faculty, alphabetically by state, 3 professorial ranks)

Institution	1988	1998	2000	Annual Change 1988-1998	Annual Change 1998-2000
U-Alabama	23.8%	23.6%	27.1%	0	1.8
AZ State U	19.1	25.2	30.5	0.6	2.4
U-AZ	14.9	26.6	30.0	1.2	1.7
CalTech	4.1	10.5	10.7	0.6	0.1
Stanford	10.5	17.3	19.0	0.7	0.9
UC-Berkeley	14.2	23.7	23.1	1.0	-0.3
Davis	14.1	26.9	24.0	1.3	-1.5
Irvine	15.1	23.9	24.8	0.9	0.5
Los Angeles	16.7	24.6	26.1	0.8	0.8
San Diego	13.7	18.0	19.6	0.4	0.8
Santa Barbara	13.8	24.2	24.7	1.0	0.3
USC	16.5	24.1	24.6	0.8	0.3
Colorado State U	12.3	20.7	22.7	0.8	1.0
U-Colorado	14.3	24.2	25.3	1.0	0.6
U-Connecticut	19.0	26.0	28.2	0.7	1.1
Yale	18.9	33.2	23.9	1.4	-4.7
Georgetown	24.3	34.8	28.9	1.1	-3.0
Howard	31.1	34.5	32.0	0.3	-1.3
Florida State U	21.2	28.9	30.4	0.8	0.8
U-Florida	14.8	22.5	23.6	0.8	0.6
U-Miami	16.9	22.0	21.6	0.5	-0.2
Emory*		31.7	30.7		-0.5

Table 1 *continued*

Institution	1988	1998	2000	Annual Change 1988-1998	Annual Change 1998-2000
Georgia Tech	6.4	11.9	13.5	0.6	0.8
U-Georgia	15.9	23.6	25.9	0.8	1.2
U-Hawaii (Manoa)	22.0	28.5	29.8	0.7	0.7
U-Chicago	12.7	19.1	21.0	0.6	1.0
U-Illinois, Chicago	21.3	28.3	29.3	0.7	0.5
U-Illinois, Urbana	12.6	19.9	21.6	0.7	0.9
Northwestern	14.6	22.1	23.8	0.8	0.9
Indiana U (Bloomington)	19.6	26.8	27.2	0.7	0.2
Purdue U (Main Campus)	14.6	21.1	21.8	0.7	0.4
Iowa State	18.8	24.9	23.5	0.6	-0.7
U-Iowa	19.8	27.6	30.5	0.4	1.5
U-Kansas	15.6	23.6	24.8	0.8	0.6
U-Kentucky	16.6	25.1	26.1	0.9	0.5
Louisiana State U	14.0	18.5	18.9	0.5	0.2
Johns Hopkins	18.2	25.5	27.1	0.7	0.8
U-Maryland (College Park)	19.5	21.1	26.5	0.3	2.7
Harvard	15.6	21.2	22.7	0.6	0.8
Mass. Inst. of Technology	9.7	14.4	15.7	0.5	0.7
Tufts	25.8	31.6	32.9	0.6	0.7
U-Mass (Amherst)	19.1	24.6	26.3	0.5	0.9
Michigan State	20.1	24.5	26.7	0.4	1.1
U-Michigan (Ann Arbor)	17.8	26.0	28.6	0.8	1.3
Wayne State U	23.7	30.5	31.0	0.7	0.3
U-Minnesota (Twin Cities)	22.3	25.8	27.6	0.4	0.9
U-Missouri (Columbia)	16.9	23.2	26.1	0.6	1.5
Washington U	13.6	22.1	22.6	0.9	0.3
U-Nebraska	20.7	20.8	21.8	0	0.5
Princeton	13.1	20.2	21.8	0.7	0.8
Rutgers	23.8	26.8	26.9	0.3	0.1
New Mexico State	16.8	30.9	30.4	1.4	0.3
U-New Mexico	17.8	33.1	35.0	1.5	1.0
Columbia	19.2	22.5	23.0	0.3	0.3
Cornell (endowed colleges)	11.4	18.8	21.3	0.7	1.3
Cornell (statutory colleges)	15.9	20.7	21.7	0.5	0.5
New York University	25.0	31.9	31.5	0.7	-0.2
Rockefeller University	14.0	17.5	22.9	0.4	2.7
SUNY Buffalo	14.8	24.6	27.5	1.0	2.0
Stonybrook	14.7	26.5	26.0	1.2	-0.3
U of Rochester	20.9	22.2	21.9	0.1	-0.2
Duke	15.2	22.3	21.8	0.7	-0.3
North Carolina State	16.6	17.2	18.5	0.1	0.7
U-North Carolina	22.1	27.7	29.2	0.6	0.8
Case-Western Reserve	15.4	24.7	25.0	0.9	0.2
Ohio State U	18.0	18.8	31.7	0.1	6.5
U-Cincinnati	24.4	33.1	34.6	0.8	0.8
Oregon State	16.8	26.7	28.9	1.0	1.1
Carnegie-Mellon	14.0	19.2	19.9	0.5	0.4
Penn State	12.6	22.8	31.5	1.0	4.4

Table 1 *continued*

Institution	1988	1998	2000	Annual Change 1988-1998	Annual Change 1998-2000
Temple	24.1	32.0	33.3	0.8	0.7
U-Pennsylvania	16.3	23.0	24.6	0.7	0.8
U-Pittsburgh	25.6	30.5	31.0	0.5	0.3
Brown	18.5	23.5	25.1	0.5	0.8
U-Tennessee	19.0	23.7	24.7	0.5	0.5
Vanderbilt	16.1	22.4	24.1	0.6	0.8
Texas A & M	10.7	15.9	16.9	0.5	0.5
U-Texas (Austin)	18.0	23.8	24.4	0.6	0.3
U-Utah	18.2	27.2	28.0	0.9	0.4
Utah State	13.5	25.0	24.9	1.2	0
U-Virginia	14.6	24.9	26.3	1.0	0.7
Virginia Commonwealth U	28.4	33.1	34.3	0.5	0.6
Virginia Polytech	12.4	18.7	19.8	0.6	0.5
U-Washington	17.1	24.5	28.0	0.7	1.7
West Virginia U	21.5	26.4	27.5	0.5	0.5
U-Wisconsin (Madison)	16.6	26.0	25.9	0.9	-0.1
Average	**17.3**	**24.3**	**25.2**	**0.7**	**0.6**

Source: Compiled from *Academe*, March-April 1988, Vol. 74, No. 2; March-April 1998, Vol. 84, No. 2; March-April 2000, Vol. 86, No. 2

Note: No data were published for Boston University. UC-San Francisco was omitted from the tabulations because, with heavy concentration in medical sciences, the results were anomalous compared to most universities

* Data for Emory were not available in 1988

Table 2

PERCENT OF WOMEN FACULTY BY RANK
Research I Universities, 1988, 1998, and 2000

(Nonmedical instructional faculty, alphabetically by state)

	1988			1998			2000		
Institution	PR*	AO*	AI*	PR	AO	AI	PR	AO	AI
U-Alabama	11.0	22.6	35.2	14.2	25.7	47.5	13.7	28.5	46.4
Arizona State U	12.1	18.2	31.7	15.7	30.9	51.2	17.5	34.0	53.7
U-Arizona	5.8	22.3	27.0	14.1	34.2	46.4	16.6	36.5	39.5
CalTech	1.2	13.5	8.6	5.4	18.6	31.0	6.8	26.7	26.1
Stanford	3.6	20.0	24.3	11.4	28.7	26.7	12.4	25.8	32.5
UC-Berkeley	8.5	21.7	31.3	16.5	38.3	34.4	15.6	40.5	33.8
Davis	7.7	20.9	23.2	19.1	35.8	40.9	17.9	37.3	33.3
Irvine	10.4	18.8	21.7	15.9	32.1	34.4	15.8	39.8	30.5
Los Angeles	8.9	23.4	33.9	18.2	35.2	33.0	19.6	35.5	35.8

Table 2 *continued*

Institution	1988 PR*	1988 AO*	1988 AI*	1998 PR	1998 AO	1998 AI	2000 PR	2000 AO	2000 AI
San Diego	7.1	23.0	25.0	12.8	22.2	33.0	14.4	27.5	31.0
Santa Barbara	8.6	21.3	28.0	15.5	32.0	40.7	16.7	33.3	42.0
U-Southern California	9.4	15.6	26.7	12.8	30.3	38.8	14.5	31.8	37.2
Colorado State	4.2	14.5	26.8	9.4	26.9	42.9	10.4	30.8	42.9
U-Colorado (Boulder)	3.7	22.0	28.9	12.4	33.0	39.0	14.0	32.8	40.1
U-Connecticut	9.2	23.8	38.3	18.7	28.9	38.6	19.5	30.1	41.9
Yale	6.2	28.6	35.9	13.7	40.2	37.3	16.2	39.4	33.3
Georgetown	8.2	23.3	41.4	19.9	38.8	45.1	23.1	37.4	48.5
Howard	14.1	35.1	45.9	21.2	40.2	45.1	18.2	37.3	47.6
Florida State	10.2	28.5	36.5	15.5	40.6	43.9	17.0	41.6	43.4
U-Florida	6.9	17.3	24.2	10.1	25.1	44.9	11.3	26.3	42.5
U-Miami	9.4	19.6	29.5	14.2	23.9	38.8	13.4	24.7	38.7
Emory#	—	—	—	17.0	37.5	44.8	18.0	37.7	49.6
Georgia Tech	1.3	8.0	13.7	3.3	12.2	25.9	5.7	15.8	23.9
U-Georgia	4.8	15.4	30.9	12.8	25.7	42.3	14.1	29.8	43.9
U-Hawaii (Manoa)	8.5	23.5	42.7	16.3	34.4	46.1	22.1	37.9	47.4
U-Chicago	6.7	21.0	21.9	13.6	23.8	30.1	14.8	27.9	31.8
U-Illinois (Chicago)	14.9	24.6	38.4	16.6	29.2	45.6	17.4	31.7	45.6
U-Illinois (Urbana)	5.9	17.4	21.6	10.1	25.7	34.8	11.5	28.0	35.7
Northwestern	6.5	22.9	23.9	13.6	28.3	34.7	14.3	30.0	40.4
Indiana U (Bloomington)	8.6	29.3	32.6	17.1	30.5	40.7	19.6	31.2	38.4
Purdue (Main Campus)	4.3	15.2	28.3	7.7	25.6	40.0	8.9	26.5	39.2
Iowa State	6.8	21.8	33.5	10.6	29.6	46.2	11.9	27.3	38.6
U-Iowa	8.6	24.2	37.4	13.7	37.8	44.7	14.6	41.7	44.8
U-Kansas	7.2	22.5	28.9	12.1	31.1	37.1	13.3	31.3	39.5
U-Kentucky	6.7	22.6	25.5	10.0	29.6	45.3	11.2	31.7	42.5
Louisiana State U	6.8	15.0	21.8	9.6	21.8	34.8	9.5	22.8	34.2
Johns Hopkins	8.9	27.4	29.9	13.2	40.7	44.4	17.2	43.4	42.8
U-Maryland (College Park)	9.9	22.3	33.5	14.3	25.2	34.1	18.1	31.6	37.9
Harvard	7.7	24.0	27.0	14.3	31.7	34.2	15.9	41.3	29.7
Mass. Inst. of Tech.	5.4	13.9	18.6	8.1	28.2	21.1	10.3	24.3	24.7
Tufts	13.2	30.1	32.5	22.8	33.5	42.2	21.3	32.9	49.2
U-Mass (Amherst)	9.1	24.7	37.2	16.0	30.7	46.1	17.8	32.6	45.1
Michigan State	10.2	25.8	36.5	15.6	32.5	37.3	16.6	35.1	40.0
U-Michigan (Ann Arbor)	8.2	23.1	33.1	14.0	32.2	42.0	16.0	37.4	41.2
Wayne State U	9.2	25.1	45.1	11.6	31.7	54.4	14.1	31.6	52.3
U-Minnesota (Twin Cities)	11.0	27.5	41.1	14.6	33.9	48.4	17.9	32.9	45.5
U-Missouri (Columbia)	5.5	18.6	34.1	12.2	24.7	37.4	15.7	26.8	40.7
Washington U	7.4	14.8	23.9	11.1	23.1	41.3	14.9	23.3	38.0
U-Nebraska	6.8	24.6	35.1	8.3	33.5	39.0	12.8	24.0	38.7
Princeton	6.0	26.8	22.6	13.1	34.5	35.0	13.8	40.7	36.3
Rutgers	12.3	28.5	37.0	16.4	32.0	45.2	16.9	33.3	41.0
New Mexico State	7.0	14.8	31.7	12.9	30.7	47.5	11.7	35.5	39.3
U-New Mexico	11.0	24.1	39.6	21.5	31.6	39.6	23.7	35.9	51.2
Columbia	10.8	26.9	30.3	16.6	31.5	29.6	17.1	30.8	31.1
Cornell (endowed colleges)	3.9	11.7	23.9	11.0	24.0	32.8	13.0	27.0	38.7
Cornell (statutory colleges)	6.8	16.9	32.7	9.6	29.3	41.4	10.6	33.3	36.3
New York University	15.9	29.9	38.5	21.0	36.7	50.0	22.5	38.3	45.5

Table 2 *continued*

Institution	1988 PR*	1988 AO*	1988 AI*	1998 PR	1998 AO	1998 AI	2000 PR	2000 AO	2000 AI
Rockefeller University	—	8.3	24.2	5.0	23.3	23.2	8.1	17.4	37.8
SUNY-Buffalo	7.2	16.0	30.4	10.4	27.7	44.2	12.5	31.5	44.3
Stonybrook	7.2	18.1	25.0	13.1	29.0	45.8	13.7	32.0	38.1
U of Rochester	6.8	21.6	40.4	11.3	29.6	32.0	12.9	30.9	32.0
Duke	6.0	23.1	27.5	12.9	28.0	36.9	14.0	29.8	30.9
North Carolina State	4.8	19.7	31.4	7.4	25.0	26.4	9.3	24.5	29.3
U-North Carolina	8.4	31.7	42.1	18.2	33.0	44.8	20.5	35.1	45.9
Case Western Reserve	5.4	15.4	31.0	12.2	34.0	41.3	12.3	33.1	43.6
Ohio State U	6.5	20.8	31.2	11.8	29.0	43.4	13.2	31.3	39.2
U-Cincinnati	10.2	27.3	41.5	17.3	32.0	44.3	19.9	32.7	45.3
Oregon State	4.8	15.9	33.7	10.9	31.2	45.7	13.5	36.1	43.1
Carnegie-Mellon	5.7	16.2	24.1	12.4	23.7	31.5	13.4	25.5	29.8
Penn State	5.0	11.5	24.9	10.8	23.3	41.0	11.2	27.8	40.1
Temple	15.4	24.4	38.7	20.7	35.3	48.2	21.8	35.5	53.6
U-Pennsylvania	8.4	19.5	30.7	15.2	24.5	43.0	16.2	27.4	42.6
U-Pittsburgh	12.2	23.5	48.0	15.1	28.0	53.9	17.7	29.6	49.1
Brown	6.9	28.6	38.9	12.5	41.6	33.3	15.9	40.0	32.9
U-Tennessee	7.9	22.0	41.6	12.5	33.6	40.7	13.5	31.7	43.5
Vanderbilt	5.0	22.7	25.3	13.0	21.9	41.9	14.7	24.8	42.3
Texas A & M	2.8	10.4	22.2	5.2	20.4	36.2	6.4	23.9	33.1
U-Texas (Austin)	7.2	24.1	32.7	12.1	32.6	44.3	13.3	33.8	42.6
U-Utah	6.5	23.3	37.4	14.5	31.9	44.7	16.0	33.4	42.6
Utah State	2.9	7.2	37.5	7.2	28.0	42.8	9.4	27.0	40.8
U-Virginia	4.4	13.1	33.3	11.6	28.4	49.3	12.1	31.9	50.7
Virginia Commonwealth U	15.8	25.5	41.9	13.3	32.0	55.0	15.3	32.7	57.8
Virginia Polytech	3.4	11.8	26.6	6.6	20.6	43.3	7.3	21.9	40.9
U-Washington	9.7	20.3	31.5	14.3	31.8	45.5	17.4	36.3	43.6
West Virginia U	8.1	23.9	40.8	10.8	25.8	50.7	11.8	27.1	49.8
U-Wisconsin (Madison)	9.3	28.2	30.7	16.2	39.7	44.1	18.4	37.5	38.6
Average	**7.9**	**21.0**	**31.5**	**13.3**	**30.0**	**40.5**	**14.4**	**31.7**	**40.3**

Source: Compiled from *Academe*, March-April 1988, Vol.74, No. 2; March-April 1998, Vol. 84 No. 2; March-April 2000, Vol. 86, No. 2
See Note, Table 1
* PR = Professor; AO = Associate Professor; AI = Assistant Professor
# Data for Emory were not available in 1988

Table 3

TENURE STATUS OF WOMEN FACULTY

Institution	Tenured	Tenure-Track	Not on Track
1995	%	%	%
Berkeley	18.5	39.4	
Harvard	12.1	*29.0	28.6

Table 3 *continued*

Institution	Tenured %	Tenure-Track %	Not on Track %
1996			
Harvard	12.6	*31.4	29.5
MIT	9.7		
Stanford	13.3	30.9	12.0
U-Georgia	18.0	43.0	47.1
U-Washington	18.3	24.1	59.2
1997			
Case-Western Reserve	24	42	50.0
Cornell (Total)	16.0	38.3	22.9
Emory	19.2	35.0	37.0
Harvard	13.4	*32.0	28.1
Howard	28.6	42.2	
Rutgers	24.7	41.8	43.5
Temple	24.0	50.5	54.5
U-North Carolina	21.7	41.5	50.0
U-Pittsburgh	17.7	41.5	44.2
U-Texas (Austin)	18.6	42.7	50.6
Yale	11.7	**15.7	40.7

Source: Compiled from the institutions' affirmative action reports for the years indicated
* Designated as "ladder" faculty
** Designated as "term" appointments

Table 4

SELECTED DEPARTMENTAL DISTRIBUTIONS OF WOMEN FACULTY
All Ranks, percentages

Institution	Biology		Chemistry		Math		English		Sociology	
	Act.	Avail.	Act.	Avail.	Act.	Avail.	Act.	Avail.	Act.	Avail.
1995										
U-Ill. (Chicago)	14.3	38.3	6.3	23.8	11.1	26.8	36.2	56.4	33.3	40.4
1996										
Berkeley	24.7	28.9	9.5	15.7						
Duke	28.1		13.6		5.9		36.8		38.9	
U-Massachusetts	22.2	39.2	12.5	21.4	6.5	17.0	26.0	51.4	24.0	42.6
1997										
Carnegie Mellon	36.0		20.0		15.0		50.0		26.6	
UC-Santa Barbara	21.1	38.3	8.4	24.8	6.9	21.1	32.4	58.2	30.8	51.7

Source: Compiled from institutional affirmative action reports

Table 5

WOMEN'S SALARIES AS PERCENT OF MEN'S, BY RANK
Research I Universities—1988, 1998, 2000

Institution	1988			1998			2000		
	PR*	AO*	AI*	PR	AO	AI	PR	AO	AI
U-Alabama	94	96	84	95	91	94	92	92	91
Arizona State Univ.	94	95	91	90	93	92	89	91	95
U-Arizona	91	97	93	88	94	97	90	95	97
Cal Tech	–	–	–	83	96	93	87	91	100
Stanford	82	100	93	94	98	93	95	95	93
UC-Berkeley	86	93	94	90	95	98	89	100	94
Davis	92	95	94	90	94	97	91	94	97
Irvine	82	92	102	89	98	93	94	99	97
LosAngeles	90	92	98	88	94	94	90	99	86
SanDiego	82	98	96	89	95	94	89	94	91
SantaBarbara	90	96	90	85	94	95	86	96	99
U-Southern California	83	91	89	91	95	96	90	92	90
Colorado State U	88	93	95	90	94	98	90	96	94
U-Colorado (Boulder)	85	95	98	91	94	92	91	94	92
U-Connecticut	90	93	97	88	92	94	89	93	97
Yale	95	94	90	92	91	90	92	91	91
Georgetown	100	104	93	94	100	91	92	104	84
Howard	99	97	95	92	99	96	89	100	90
FloridaStateU	87	91	89	91	95	96	94	92	93
U-Florida	82	91	89	90	95	91	91	93	89
U-Miami	88	95	92	98	97	93	93	96	93
Emory	–	–	–	85	90	91	83	90	90
Georgia Tech	–	89	89	87	94	94	94	96	93
U-Georgia	94	94	91	96	97	94	96	97	98
U-Hawaii (Manoa)	89	96	96	92	96	96	90	95	95
Northwestern	92	92	90	91	95	83	88	98	84
U-Chicago	87	97	90	92	98	93	92	91	87
U-Illinois (Chicago)	91	98	87	92	98	93	92	95	92
U-Illinois (Urbana)	85	91	90	86	95	95	86	95	92
Indiana U	88	90	88	88	92	93	90	93	92
Purdue	85	90	81	82	92	91	84	94	91
Iowa State U	93	90	84	90	88	95	89	89	95
U-Iowa	89	89	84	89	89	93	89	90	90
U-Kansas	88	93	89	91	96	94	90	97	96
U-Kentucky	92	92	87	92	95	95	93	98	92
Louisiana State U	91	94	91	90	95	93	94	93	96
Johns Hopkins	88	93	90	97	95	95	85	99	95
U-Md. (College Park)	97	95	93	91	97	95	92	96	88
Harvard	88	77	102	89	97	92	92	94	97
MIT	87	88	99	89	97	93	94	96	92
Tufts	90	92	95	89	99	90	89	94	96
U-Mass. (Amherst)	94	96	93	93	93	91	92	92	92
Michigan State U	89	93	92	92	96	95	93	98	91
U-Mich. (Ann Arbor)	85	89	88	92	89	93	94	90	96

Table 5 *continued*

Institution	1988 PR*	1988 AO*	1988 AI*	1998 PR	1998 AO	1998 AI	2000 PR	2000 AO	2000 AI
Wayne State U	95	101	94	96	96	101	94	96	98
U-Minn. (Twin Cities)	91	91	89	92	96	93	92	94	94
U-Missouri (Columbia)	92	95	92	88	96	88	87	93	96
Washington U	89	89	92	94	92	97	96	93	88
U-Nebraska	94	94	95	87	94	94	88	94	97
Princeton	92	97	93	94	92	99	97	94	96
Rutgers	96	96	92	93	94	96	92	95	99
New Mexico State U	91	90	90	89	94	91	87	94	91
U-New Mexico	93	90	95	86	95	95	89	91	98
Columbia	85	98	98	91	95	96	91	87	94
Cornell									
(endowed colleges)	83	94	89	89	92	99	94	88	97
(statutory colleges)	93	95	100	93	97	96	95	97	104
New York University	88	97	91	90	92	90	87	96	89
Rockefeller		97	97						96
SUNY-Buffalo	84	90	91	88	90	94	91	91	94
SUNY-Stonybrook	89	90	92	87	95	96	89	99	94
U of Rochester	88	91	79	81	88	90	81	90	79
Duke	111	97	90	93	90	91	95	88	97
North Carolina State U	87	93	94	88	9	97	87	91	94
U of North Carolina	88	95	88	91	92	97	95	95	95
Case Western Reserve	91	99	91	91	94	91	93	96	88
Ohio State U	90	94	89	94	90	95	92	94	99
U-Cincinnati	89	97	92	87	93	92	89	90	96
Oregon State U	91	95	91	99	94	94	101	94	92
Carnegie-Mellon	79	82	88	82	85	83	84	85	88
Pennsylvania State U	89	94	84	93	90	94	93	91	91
Temple	89	91	96	93	94	99	92	92	102
U-Pennsylvania	92	95	88	96	90	84	90	87	80
U-Pittsburgh	88	95	92	88	96	93	89	95	90
Brown	86	92	90	94	93	99	93	96	94
U-Tennessee	88	91	93	88	97	91	81	91	86
Vanderbilt	88	97	84	89	86	93	90	88	92
Texas A&M	89	89	88	92	92	96	90	93	94
U-Texas(Austin)	86	93	86	87	94	89	88	94	89
U-Utah	84	94	89	86	96	82	87	97	88
Utah State U		91	93	91	87	93	94	89	93
U-Virginia	96	97	90	93	96	98	94	93	100
Va. Commonwealth U	90	91	93	94	98	96	94	94	88
Virginia Polytech	89	92	95	81	93	97	82	92	100
U-Washington	89	94	93	91	92	93	92	93	94
West Virginia U	88	89	89	91	95	95	90	96	97
U-Wisconsin (Madison)	87	90	89	87	92	91	85	92	90
Average	**88**	**93**	**91**	**90**	**94**	**94**	**91**	**94**	**93**

Source: See Table 1

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Chapter Four

Gender, Faculty, and Doctoral Education in Science and Engineering[1]

Mary Frank Fox

INTRODUCTION

Initiatives to increase the numbers of women faculty derive in part from understandings that the representation of women faculty is crucial for the culture and climate of the university and for the development of students' capacities and potential. Faculty are consequential for students through what they convey, demonstrate, and exemplify. This is true throughout educational stages. But it is the case particularly for doctoral education. For graduate students, the impact of faculty is broad and deep—affecting the way students acquire knowledge, values, norms, skills, and beliefs (Zuckerman 1977). Graduate students report that faculty are the single most important aspect of their education (Clark and Corcoran 1986; Katz and Hartnett 1976). That influence, however, may be for better or worse, positive and/or negative (as is the case for undergraduate education; see Astin and Sax 1996). For those students who enter academic careers, the effects of their graduate school faculty are often so strong as to provide perspectives and orientations that guide their lifetimes of teaching and research (Trow 1977:15).

What we need to know—and largely have not—are features of the *social complexity and dynamics of faculty in doctoral education*, as they vary

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both by gender of faculty and by faculty's reference to gender of students. That is my subject in this chapter. The focal questions are these: In science and engineering fields, do women and men faculty have comparatively different or similar patterns in 1) the gender composition of advisees and research team (student) members; 2) the nature/character of their interaction with advisees; and 3) their beliefs about what is important in doctoral education for female compared to male students? By implication, these questions go to a fundamental issue: What are the consequences of having women faculty? How and why does it *matter* to have women as well as men faculty?

In the study of gender, faculty, and doctoral education, science and engineering (S&E) fields represent a revealing site for research. This is because scientific work and training revolve strongly on faculty-student interchange. In science and engineering, faculty and students are bound together potentially in research facilities and projects, funded through faculty as principal investigators, on which students largely undertake daily work (see, for example, National Research Council 1998). In these fields, students rarely, if ever, go off to do research and dissertations "on their own"; thus, faculty have particular immediacy and exigency in the students' lives (Fox 2000).

METHOD

DATA

The data are from a national mail survey that I conducted in 1993-94 of 1215 faculty in doctoral-granting departments of: computer science, chemistry, electrical engineering, microbiology, and physics. The study is distinguished by sampling of faculty from known populations. Details on sampling design are in the Appendix. Response rate of faculty to the survey was 69%—with those faculty in computer science and electrical engineering having somewhat lower, and those in chemistry and physics having somewhat higher, response (than average); and with women's response rates somewhat higher than men's.

VARIABLES

Gender compositions of *advisees* and *research teams* are represented by faculty's reports of: 1) the number of male and female students for whom faculty "act as primary research advisor"; and 2) the number of male and female graduate students on the faculty's research team (for those who conduct their research as "a team group of persons").

Features of *faculty interactions* with students are represented by faculty's reports on: 1) orientation to graduate training; 2) characterization of ideal relationship with students; 3) structure of working with students; and 4) frequency of speaking with advisees. *Orientation to graduate training* is measured by response to the question, "If you have one of the following orientations toward graduate education, which orientation fits you best: a) move students along; teach them to succeed; or b) sift through students; let them sink or swim?" *Characterization of ideal relationship* with students is assessed through faculty's response to the question, "Ideally, how do you envision the relationship between advisor and doctoral-level graduate student: a) as one between faculty member and student; b) as one between mentor and mentee; or c) as one between colleagues?" The *structure of working with students* is assessed with faculty's response to the question, "To discuss a student's research, do you usually make an appointment or not?" *Frequency of interaction* is measured by answer to the question, "How frequently do you discuss research projects and interests with advisees: almost never, once/twice a term, once/twice a month, once a week, almost every day, several times a day?"

Faculty attitudes and beliefs about what is important in doctoral education are indicated in the scaled levels of importance ("not important," "slightly important," "moderately important," or "very important") faculty place upon: 1) twelve *areas of help for advisees*; 2) eight *areas of skills/capacities* in students' attainment of the doctoral degrees; and 3) seven *factors accounting for success among students*. For the importance of skills/capacities and factors accounting for success, faculty were asked for separate ratings of importance for male students and for female students.

The findings are for faculty across fields, separated by gender; the limited numbers of women faculty in S&E fields do not lend themselves to gender comparisons separated by field. Figure 1 shows the distribution by departments of women faculty and men faculty in the study; the distribution of women and men faculty by their academic ranks appears in Table 1. Throughout, and simply for rhetorical purposes of distinguishing between gender of faculty and of students, I refer to faculty as "women and men faculty" and students as "female and male students."

Figure 1

FACULTY PROFILE BY DEPARTMENT

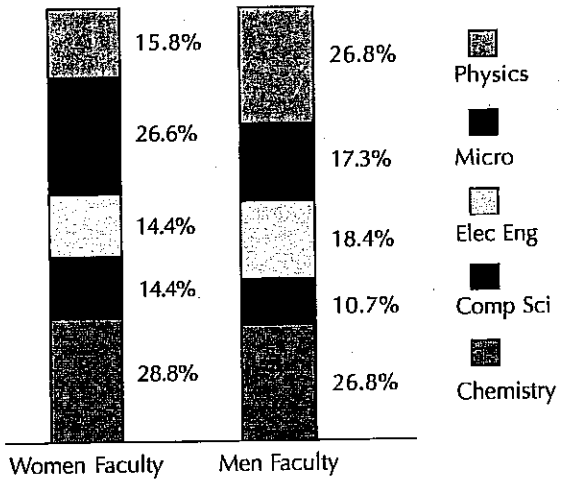


Table 1

FACULTY PROFILE BY RANK

Rank	Women Faculty (N=137)	Men Faculty (N=628)
Instructor/Lecturer	2.2%	0.5%
Assistant Professor	40.9%	17.4%
Associate Professor	23.4%	20.4%
Full Professor	29.2%	56.4%
Named Professor	1.4%	2.9%
Admin., Res. Fac., Adjunct	2.9%	2.9%

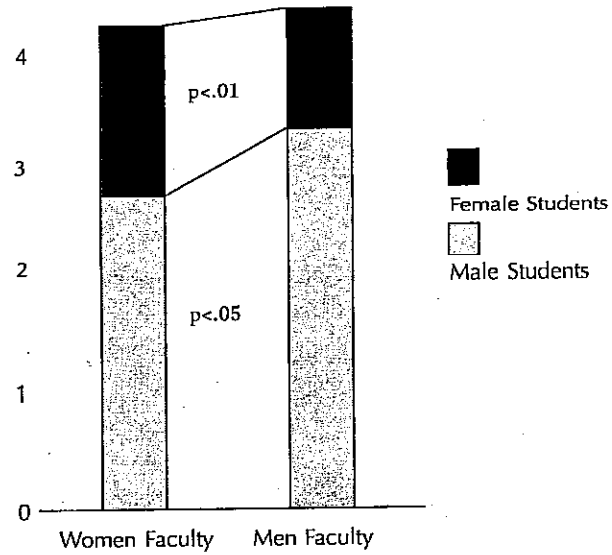
FINDINGS AND DISCUSSION

ADVISING AND RESEARCH TEAMS: STUDENT COMPOSITION BY GENDER OF FACULTY AND OF STUDENTS

The vast majority of faculty—88% men, 84% women—act as primary research advisors for graduate students. By gender, *who* advises *whom*?

Figure 2

NUMBER OF STUDENTS ADVISED

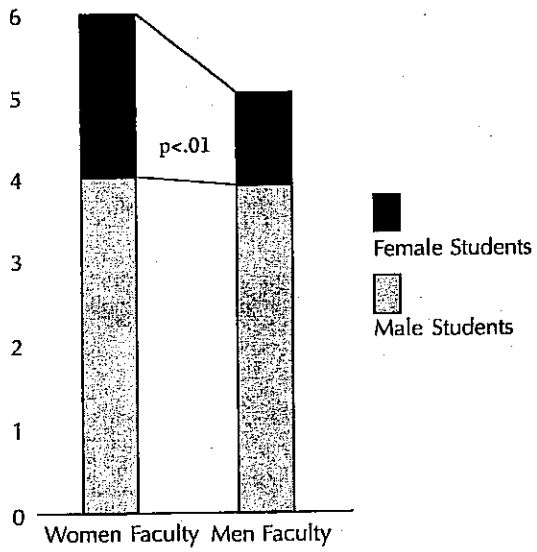


Compared to men faculty, women advise more female students and fewer male students; for men faculty, it is the reverse. In total number of students advised, women and men faculty do not significantly differ (Figure 2).

The data on advising include those who do and do not conduct their research in what is described as "teams." The 70% majority of faculty report that they conduct their research as "team research" with groups of graduate students, and sometimes post-docs as well as other participants such as technicians and undergraduates, working together on a project. What is the composition of research teams, by gender of faculty and students? Women faculty doing team research have a larger number of female graduate students in their groups than do men faculty. However, women and men do *not* differ significantly in the number of male students on their teams. Thus, if women faculty have more students on their teams (and they do), it is because the number of female students is higher (Figure 3).[2]

Figure 3

NUMBER OF STUDENTS ON RESEARCH TEAM



FACULTY INTERACTIONS WITH STUDENTS: ORIENTATION/ CHARACTERIZATION, STRUCTURE, AND FREQUENCY

Faculty interactions with students involve faculty's orientation to doctoral education, and the structure and frequency of interaction. These data on interactions refer to students advised without reference to gender of students.

Orientation and Characterization

In assessing "general orientation" to graduate training, two types of orientations were posed to faculty: 1) that of taking a stance to "moving students along and teaching them to succeed," and 2) "sifting through students, letting them sink-or-swim." The majority of faculty—78% of women, 74% of men—reported "yes," they have one of these orientations. Of these, over 90% of both women and men faculty report their own orientation is "moving students along/teaching them to succeed." On this, both women and men faculty overwhelmingly agree (Table 2).

Table 2

FACULTY ORIENTATION TO STUDENTS

Orientation to Students	Women Faculty	Men Faculty
Teach Them to Succeed	90.8%	91.5%
Let Them "Sink or Swim"	5.5%	7.0%
Both	2.8%	0.8%
Depends	0.9%	0.6%

Table 3

IDEAL RELATIONSHIP WITH STUDENTS

Relationship	Women Faculty	Men Faculty
Faculty–Student	3.6%	3.0%
Mentor–Mentee	82.0%	76.1%
Colleagues	9.4%	12.7%
Combination	5.0%	8.2%

In the ways in which faculty envision the ideal relationship between advisor and advisee—as "faculty and student," "mentor and mentee," or "colleagues"—we begin to see marks of patterns for women and men faculty. It is not, however, a pattern of women idealizing peership with students. Compared to men, women faculty are more likely to cluster in their response that the ideal relationship is "mentor/mentee." Men's characterizations are more variable, with somewhat higher proportions of men choosing "colleagues" or saying that it is a "combination" or that "it depends" (Table 3).

Structure

In the structure of working with students, by appointment or not by appointment, gender shapes practice. Less than a third (28%) of men faculty compared to 41% of women faculty discuss by appointment (Figure 4, next page). This, in combination with the clustering regarding ideal relationship, suggest that women faculty may have an approach with students that is "by design"—that is, a more deliberate, perhaps more consciously "intentional," pattern.

Figure 4

MEET WITH STUDENTS BY APPOINTMENT

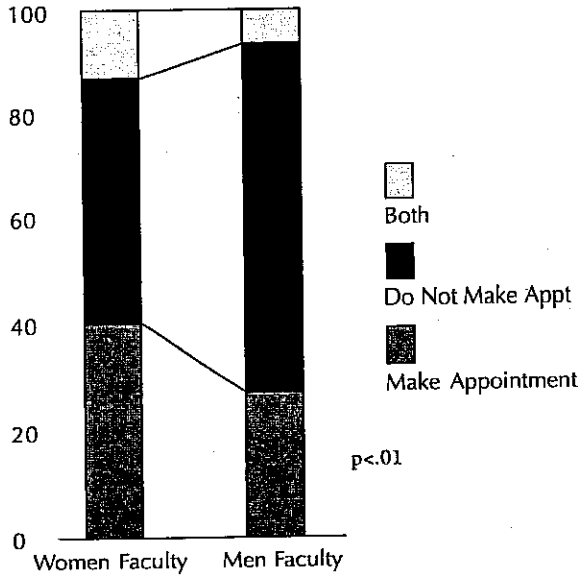


Table 4

FREQUENCY OF DISCUSSION WITH STUDENTS

Frequency	Women Faculty	Men Faculty
Once a month or less	6.0%	5.6%
Once a week	45.7%	38.5%
Almost every day	35.3%	47.7%
Several times a day	11.2%	8.1%
Varies with need	1.7%	0.4%

Frequency

Further indication of this pattern is in the response to the question "how frequently does the faculty member speak with advisees about the students' research?" For women faculty, the most common response is "once a week"; for men faculty, "almost every day" (Table 4). Women faculty's discussion with students by appointment or "by design," shown in Figure 4, is consistent with discussion once a week. Men faculty's discussion without appointment may be less structured, more casual perhaps, and thus, more frequent, which is what we see in Table 4.

FACULTY ATTITUDES AND BELIEFS ABOUT WHAT IS IMPORTANT IN DOCTORAL EDUCATION

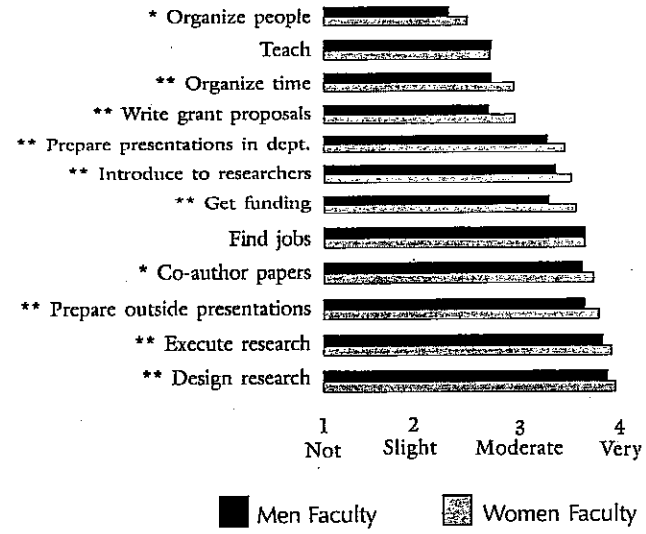
Faculty's attitudes/beliefs about doctoral education are indicated in the levels of importance faculty place upon: 1) areas of help for students, 2) areas of skills/capabilities for students, and 3) factors that account for success of students.

Importance of Help, by Type

Presented with twelve areas of help for advisees, faculty were asked to rate the importance of each area on a four point scale, where 1 = not important, and 4 = very important (Figure 5). This question does not distinguish between help for male or female students. Both women and men faculty

Figure 5

HOW IMPORTANT TO HELP STUDENTS

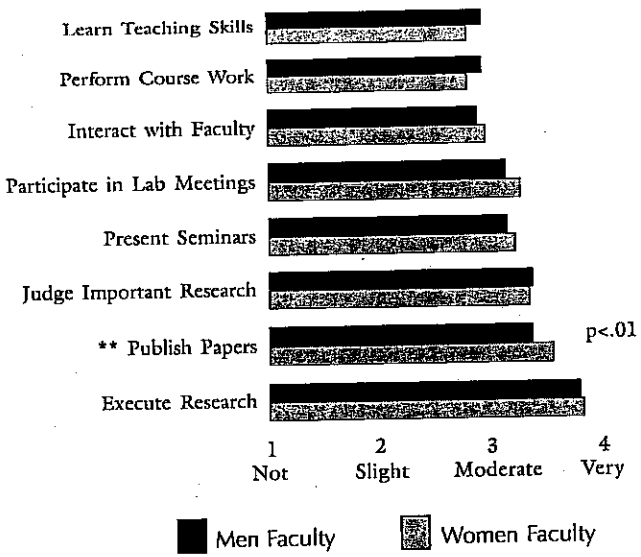


rank certain areas of help to be most important, namely help in designing research, executing research, making outside presentations, co-authoring papers, and finding jobs. Among women and men faculty in science and engineering, *consensus* is then high on ranking of what is important help for doctoral students. In non-science fields, consensus is generally much lower about a range of fundamental issues, including what constitutes an important (compared to an insignificant) question, an elegant (compared to banal) research design, and a grand (compared to a trivial) problem (Fox, 1989:189). Likewise, in non-science fields, agreement about what is important in doctoral education may also be expected to be lower among faculty, including women compared to men faculty.

At the same time, however, for 10 of these 12 areas of help, women faculty in these science and engineering fields rank the help as significantly *more important* than do men faculty (these 10 areas are starred in Figure 5). The only areas of help in which women do not give significantly higher rankings of importance are in "learning teaching skills" and "finding jobs." In short, across all areas of help but these two, women

Figure 6

IMPORTANCE OF SKILLS: MALE STUDENTS



faculty are significantly higher in the weight or emphasis put upon help to advisees.

Importance of Students' Skills/Capacities in Attaining Degree

Graduate education is linked—directly and indirectly—to professional participation and performance, and it involves acquiring research skills and judgment and interactional capacities (Zuckerman 1977). Accordingly, in a second set of questions about beliefs/attitudes, faculty were asked how important they considered the attainment of eight areas of skills/capacities for male students, and in a separate rating, for female students.

In their assessments for male students, women and men faculty are similar in the levels of importance placed upon areas of skills/capacities, except for women faculty's stronger emphasis upon the importance of publishing papers (Figure 6). For female students, however, women faculty not only maintain that students' publishing of papers is more important than do men faculty; they also put more emphasis on the importance of interactional capacities (Figure 7). Specifically, for female

Figure 7

IMPORTANCE OF SKILLS: FEMALE STUDENTS

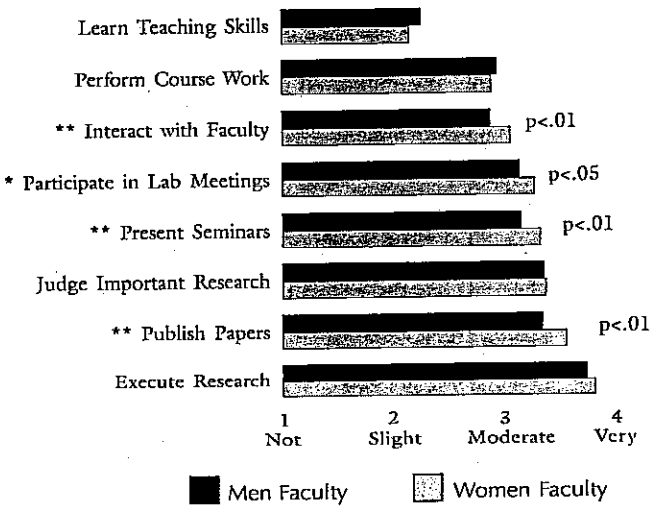
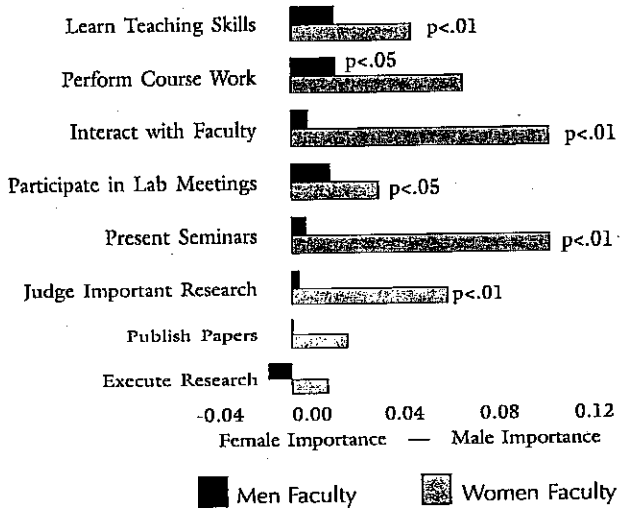


Figure 8

IMPORTANCE OF SKILLS: FEMALES VS. MALES



students, women faculty place significantly higher rating than do men faculty upon the importance of presenting seminars, participating in laboratory meetings, and interacting with faculty.

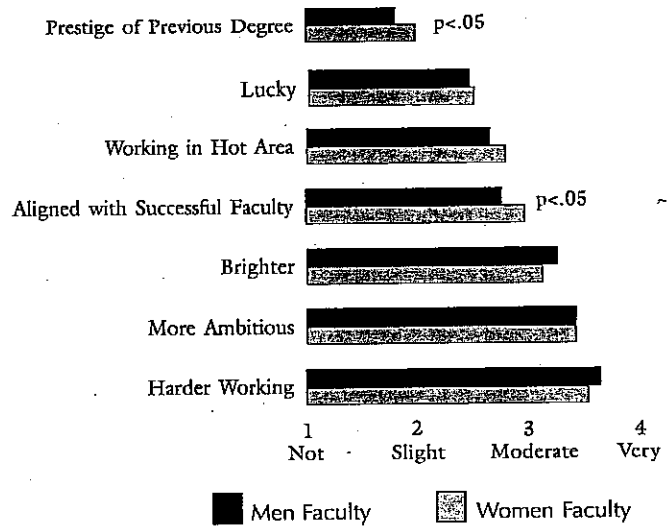
Further, the contrasts between women faculty's assessment of the importance of certain interactional capabilities for female *compared to* male students—that is, the paired comparisons—are significant. Figure 8 shows the level of importance for females minus level of importance for male students (thus, positive values indicate the skill is more important for female students). In this way, we see that women faculty believe that all skills, except publishing papers, are unevenly important by gender of student—that is, more important for female than for male students.

Importance of Factors Accounting for Success

A third set of beliefs are faculty's accounts of the importance of factors explaining success of students. These are sometimes called "attributions of success." Attributions can vary in emphasis placed upon factors that are more (comparatively) "internal" to the students themselves, such as being

Figure 9

SUCCESS ATTRIBUTIONS: MALE STUDENTS



"ambitious" or "hard working," and those more "external" to the students, such as "being aligned with successful faculty" or "working in a well-funded area" (Fox and Ferri 1992).

In their ratings of factors that account for the accomplishment of the "most successful" students, both women and men faculty put their strongest emphasis—that is, highest ratings of importance—upon "ambition" and "hard work," factors more internal to students. In attributions for the success of male students, women faculty think that "alignment with successful faculty" and "having prior degree from a prestigious university" are significantly more important than do men faculty (Figure 9). Women faculty are putting greater emphasis upon the importance of comparatively "external" factors. For female students, women faculty think that the *majority* of factors—internal factors *and* external factors—are more important than do men faculty (Figure 10, next page).

Another way to view the pattern is in the paired comparisons in levels of importance faculty place upon factors for female compared to male students. Figure 11, next page, shows the difference between ratings of the importance of factors for female *compared* to male students among women faculty and men faculty. Among women faculty, the difference is

Figure 10

SUCCESS ATTRIBUTIONS: FEMALE STUDENTS

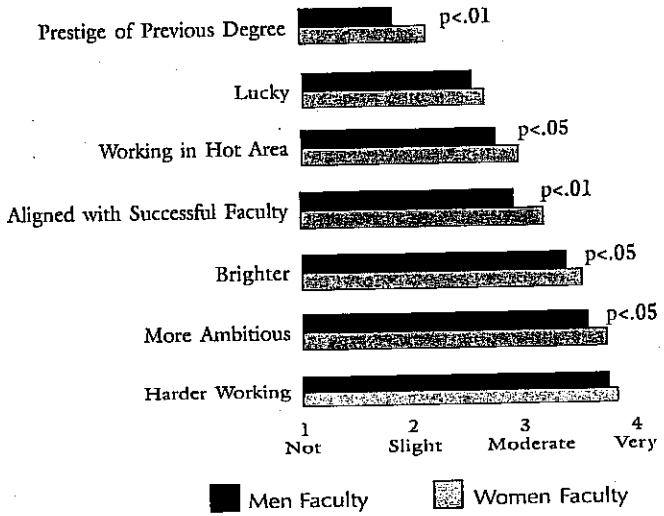
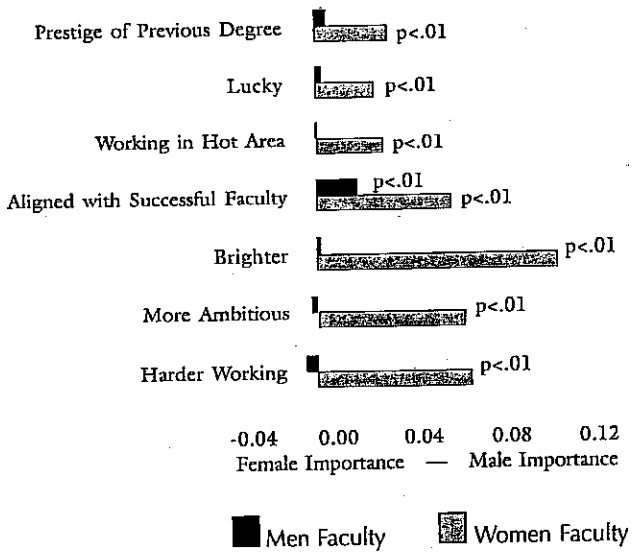


Figure 11

SUCCESS ATTRIBUTIONS: FEMALES VS. MALES



significant for 5 out of 7 of the factors—for each area except "working in a hot area" and "being lucky." In short, women faculty believe *most* factors are more important for the success of female compared to male students.

SUMMARY AND CONCLUSIONS

In summary and conclusion, let us consider the findings as they bear upon issues fundamental to practices and policies to increase the representation of women faculty. Specifically, what are the consequences of having women faculty? In what ways does it matter to have women (as well as men) faculty?

First, compared to men, women faculty act as primary research advisors for a larger number of female students.

Second, for those faculty doing "team research" (and this is the 70% majority in these S&E 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. On the average, then, women faculty are not substituting female for male students; they are including both, and have larger groups.

Third, in the features of their interaction with students—indicated by orientation to students, and structure and frequency of interaction—women are more likely than men faculty to proceed in what might be termed a "deliberate" manner. Women are more likely to regard the ideal relationship as "mentor-mentee," to make appointments to see students, and to discuss students' research with them each week, as though "by design." This structured approach may be linked to equity of access and treatment; that is, by making appointments and meeting with students once a week, women faculty may be consciously aiming to provide equitable or relatively uniform access of students to their advisor.[3]

Fourth, in beliefs about what is important in doctoral education, women faculty put significantly more emphasis upon giving help to advisees, across areas of help. When reference is made to gender of students, women faculty place greater importance for female compared to male students on a range of skills/competencies, not only publication of papers, but also a span of interactional capacities. Women faculty believe that participating in laboratory meetings, making presentations, and interacting with faculty are unevenly important by gender, that is, significantly more important for female than male students.

Finally, women faculty may make a difference in the extent to which they believe that success of female students, especially, is governed not

only by "ambition" and "hard work" but also by factors more external to students, such as "alignment with successful faculty." Thus, women faculty are recognising the role of social and organisational opportunities/constraints, as well as personal characteristics, in understanding and explaining success for female students.

What underlies these patterns of gender, faculty, and doctoral education? Why do women faculty place significantly more importance—more emphasis—upon facets of graduate education, especially for female students? At the heart of the matter, I propose, is heightened awareness among women faculty of their faculty positions, of the path that took them there, of the complex conditions that may govern attainments, and of the penalties for shortfall in any dimension. Different experiences of women and men faculty, and different resources, ease of opportunities, and privileges (Fox 1991), may engender differences in their interaction with students and attitudes and beliefs about matters of importance. Women and men faculty *do* experience objectively (and subjectively) different social conditions in science and academia, particularly in the slower and lower rate of promotion of women faculty, and the lower returns to women of rewards of salary and rank for performance (Fox 1996, 1999). To the extent that differential conditions prevail for female graduate students as well, women faculty's more emphatic emphasis upon matters of importance may be a realistic adaptation, not only for themselves, but for the preparation of female students—at least until (and if) more gender equitable conditions reign in academia.

NOTES

1. The research reported here was supported by a grant from the National Science Foundation (SED-9153994).

2. The number of students for whom women and men faculty serve as "primary research advisors" does not correspond strictly to the number of students women compared to men faculty report as being on a "research team." First, while the vast (87%) majority of faculty serve as primary research advisors for one or more graduate students, 30% of those who advise do not conduct "team research." Second, faculty may have on their research teams students for whom they do not (yet) serve as research advisors because of the early stage of the students' work.

3. For the suggestion of the relationship between structure of interaction and equitable access, I thank Angela Ginorio.

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APPENDIX: SAMPLING DESIGN

For each of the fields (except microbiology, discussed subsequently), the doctoral granting departments sampled were those, identified on the basis of data from the National Research Council (NRC), Survey of Doctoral Recipients, as being a) consistently low, b) consistently high, or c) most improved in proportions of doctoral degrees awarded to women over a 17-year period.

For chemistry, computer science, electrical engineering, and physics, the rate of degrees awarded to women was computed for the first five years and the last five years of the period for which data were available. The first five years were 1974-78 except for computer science (1978-1982) and electrical engineering (1977-81); the last five years were 1986-90. Within each field, the departments were ranked based upon the total number of Ph.D.s produced during the period. The largest Ph.D. departments (those producing 70% of all doctorates in the field) were selected as the "population of interest," except for computer science where a 50% cutoff was used.

Within each of the four fields, departments were then ranked, based on the difference between the ending rate of women Ph.D.s (i.e., the rate over the last five years) and the beginning rate (i.e., the rate over the first five years). For chemistry, the "most improved" departments were those with an increase of 15% or more in the rate of women Ph.D.s . For computer science and engineering, the most improved were 8% or more, and for physics, 9% or more. For each of the four fields, the "consistently low" and "consistently high" departments were those for which the difference in the rate of women Ph.D.s was within a range of not more than -5% and +5%. Within each field, the consistent departments were then ranked, based on the average of the beginning and ending rates. Depending upon the field, cutoffs were selected by "low" consistent rate and "high" consistent rate. By field, the cutoff points are: chemistry, high ≥15%, low

≤13%; computer science, high ≥10%, low ≤8%; electrical engineering, high ≥5%, low ≤1%; physics, high ≥8%, low ≤4%.

The study is distinguished by sampling of faculty from known populations. To accomplish this, I obtained rosters of faculty from the respective departments determined through the NRC data. Because of the low proportions of women compared to men faculty in these four S&E fields, and the aim for sufficient numbers to allow gender comparisons, sampling fractions were applied separately for male and female faculty. For the departments in these four fields, all women and 40% of men were sampled. Likewise, because the study focused upon differences in organizational and outcome variables among departmental categories (low, high, improved), it is desirable to put those categories in the design and not leave sample outcome to randomness of departmental categories.

Microbiology cannot be sampled with the same design (of departments that have been low, high, or improved in proportions of degrees awarded to women). That is because for microbiology, the field in which students identify degree (in NRC Survey of Doctoral Recipients) corresponds more loosely with department. For example, a degree listed as field of biology or microbiology may be from variable departments, such as molecular genetics, neurobiology, or other units. Thus, for microbiology, rosters of faculty and students were obtained from 69 responding departments of the 103 US doctoral-granting departments of microbiology in the listing of "Colleges and Universities Granting Degrees in the Microbiological Sciences," American Society of Microbiology. The sample of faculty was drawn from the 19 departments granting 50% of all microbiology degrees. Sampling fractions were applied separately for women and men faculty, with 40% of male faculty and 50% of female faculty sampled.