FACTORS AFFECTING THE REPRESENTATION OF WOMEN AMONG ENGINEERING FACULTY

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This presentation to the joint membership of WEPAN and NAMEPA was to have presented the latest data, based on two research activities of the National Research Council's Committee on Women in Science and Engineering, about the reasons underlying the small representation of women, particularly minority women, among engineering faculty at U.S. institutions. Those two activities—*Databook on Female Engineering Faculty* and *Study of Gender Differences in the Career Outcomes of Ph.D. Scientists and Engineers*—are still in progress. As a result, I can share here only some of the descriptive data on which these studies are based.

BACKGROUND

During the past three years, a CWSE study panel has examined the status of men and women working in the three major employment sectors: academe, industry, and government. The career outcomes examined include employment status; employment sector; work experience; salary; primary work activity; tenure status, rank, and government research support of academically employed; productivity; and, for those employed in nonacademic sectors, positions in management. Although binomial regressions were run in order to identify relationships between a number of antecedent conditions—such as gender, race/ethnicity, level of parents' education, and marital status—the regression analyses have not been completed and, therefore, cannot be discussed here. One can, however, learn about many gender differences in career outcomes, by examining descriptive data from the biennial Surveys of Doctoral Recipients conducted by the NRC for a consortium of federal agencies—including employment status, employment sector, years of full-time experience, primary work activity, tenure status, and academic rank.

CWSE, within the past year, has also conducted a Survey of Female Engineering Faculty at U.S. institutions, from Research I and II universities to 2-year technical institutions.

TABLE 1: Employment Status of Ph.D. Scientists and Engineers, 1973, 1989, and 1995, by Sex (in percent)

Employment Status	1973		1989		1995	
	Male	Female	Male	Female	Male	Female
All S&E						
Full-Time	91.1	66.4	86.9	75.0	82.3	73.2
Part-Time	1.7	12.8	3.2	11.1	3.5	10.5
Postdoc	2.3	4.7	2.7	5.2	3.6	6.5
Not Employed, Seeking	0.9	3.4	0.6	1.7	1.3	1.4
Not Employed, Not Seeking	0.3	4.6	0.2	3.0	1.0	4.8
Engineering (Ns)	35,103	572	72,323	2,278	81,749	4,277
Full-Time	95.2	71.0	91.2	86.5	87.7	78.9
Part-Time	1.2	12.9	2.7	6.3	2.4	6.5
Postdoc	0.9	0	1.1	3.5	2.0	5.6
Not Employed, Seeking	0.8	--	0.6	1.1	1.5	4.4
Not Employed, Not Seeking	0.3	--	0.2	1.6	0.7	3.8

NOTE: N's are weighted. Column percentages do not total 100 due to the omission of respondents to the Survey of Doctorate Recipients who did not indicate gender or employment status. Table excludes retirees.
-- indicates cell sizes too small.
SOURCE: National Research Council, Surveys of Doctorate Recipients.

EMPLOYMENT STATUS

Overall, the number of female science and engineering (S&E) Ph.D.s employed during the period 1973-1995 increased by a factor of 6.3 (from 18,468 to 116,642), while women's share among employed S&E Ph.D.s more than doubled (from 8.5 percent to 21.5 percent). The gains by women in engineering were even greater—increasing in number by a factor of 35.9 (from 124 to 4,446) during this same time and in percentage of all employed engineering Ph.D.s by a factor of 12.8 (from 0.4 percent to 5.1 percent of the total).

However, Table 1 shows that, in engineering, consistently higher percentages of men than women were employed full-time, ranging from differences of about 24 percentage-points in 1973 to less than 5 percentage-points in 1989, but the 1995 data show a widening of the gap (87.7 percent of men were employed full-time compared to 78.9 percent of women). At the same time in engineering, consistently higher percentages of women were found in the other employment categories: in 1995 about 2.5 times more women than men were employed part-time, about 3 times as many women than men held postdoctoral appointments, 3 times as many women than men were not employed but

seeking employment, and more than 5 times as many women than men were not employed but not seeking.

Women's representation among employed engineers has grown slowly during the 22-year period examined here—from 1.6 percent to 5.0 percent, an average of 0.15 percentage-points per year. Keep in mind that Mildred Dresselhaus, professor of engineering at MIT, and others have estimated that critical mass is achieved when about 14 percent of engineers are women. One can only ask, "How many of us will be here in the year 2053, the year when women will have become a critical mass, if their rates of participation continue to rise by only 0.15 percentage-points annually?" The lack of a critical mass, the lack of role models, surely discourages women, particularly minority women, from pursuing engineering education and employment.

EMPLOYMENT SECTOR

Traditionally, academe has been the primary sector of employment for S&E Ph.D.s, and higher percentages of women than of men have been employed in academe rather than in business/industry or government. In engineering, however, industry has become the primary employer of both women and men. The trends in employment sector reflect those in employment status—that is, although the gender gap of percentages employed in academe both overall and in engineering had begun to decrease during the years 1989-1995, the gaps widened beyond the percentage-point differences of 1973. The latest data, shown in Table 2, reveal that 41 percent of female engineering Ph.D.s are employed full-time in academe, compared to about 32 percent of men.

Women had comprised 8.9 percent of engineering faculty at universities and 4-year colleges in 1973; critical mass had been achieved by 1989, when women were 18 percent of faculty at these types of institutions; but only 6.5 percent of engineering faculty were

TABLE 2: Full-Time Employment of Ph.D. Scientists and Engineers at Universities and 4-Year Colleges, in 1973, 1989, and 1995, by Sex (in percent)

	1973		1989		1995	
	Male	Female	Male	Female	Male	Female
All S&E	55.7	66.0	48.4	51.8	44.7	49.6
Engineering (Ns)	11,702	1,143	20,468	4,493	24,292	1,661
	38.7	49.0	36.0	41.0	31.6	41.0

NOTES: N's are weighted. Table omits responses to the Survey of Doctorate Recipients that did not indicate gender or employment sector.
SOURCE: National Research Council, Surveys of Doctorate Recipients.

female less than two years ago. If educators and policymakers are concerned about the small representation of women among engineering faculty and concerned about achieving the critical mass that might encourage young women to earn engineering degrees and pursue academic employment in engineering, why don't all engineering departments employ women who could be role models for young women who are capable and interested in such careers? One must ask, "What in the environment of engineering departments or schools is supportive of female engineering students and faculty, and what aspects of that environment have contributed to the current decline in critical mass?"

Career success of those employed in academe center around tenure status and rank.

TENURE STATUS

At the same time, data from the SDR indicate that women holding S&E Ph.D.s are less successful than men in gaining tenure (Table 3). The 27 percentage-point difference in being tenured among scientists and engineers overall decreased by 1.5 percentage-points between 1981 and 1989 but then increased by 0.6 percentage-points. In engineering the gap in being tenured actually increased by more than 8 percentage-points between 1981 and 1989 but was followed by a decrease of 1 percentage-point in 1993. Thus, the trend in engineering may be improving, but the gender gap remains quite large.

Further evidence that the gender gap associated with tenure is narrowing is found by examining the tenure track status of those scientists and engineers who have not yet received tenure. In science and engineering overall, increasingly higher percentages of both women and men who are not tenured do hold tenure-track positions. A positive note is that, although the percentages of men in such positions has been fairly stable at 67-68 percent, increasingly higher percentages of female scientists and engineers hold tenure-track appointments—from 44 percent in 1981, to 58 percent in 1989, to 64 percent in 1993.

Engineering departments in the United States have made greater progress in narrowing the gender gap in tenure-track status. It is impressive that the percentage of nontenured male engineering faculty who hold tenure-track positions has increased by 20 percentage-points during the 1981-1993 period. However, even more impressive is the fact that the percentage of nontenured women who are on tenure track has more than doubled during the same 13-year period. Nonetheless, before one grows ecstatic about those percentages, keep in mind that the number of female engineering Ph.D.s who can hold such positions—4,277, as shown earlier in Table 1—comprise barely 5 percent of all engineering Ph.D.s.

Again, one must consider ways to improve the academic environment even more, such that the numbers of female engineering faculty increase.

TABLE 3: Tenure Status of Ph.D. Scientists and Engineers Employed in Universities and 4-Year Colleges, 1981, 1989, and 1993, by Sex (in percent)

Employment Status	1981		1989		1993	
	Male	Female	Male	Female	Male	Female
All S&E						
Tenured	64.6	37.6	73.4	47.9	61.1	35.0
Not Tenured	29.1	51.7	26.6	52.1	38.9	65.0
• In tenure track	54.6	44.1	67.2	57.5	67.8	64.2
• Not in tenure track	45.4	55.9	32.8	42.5	32.2	35.8
Engineering						
Tenured	65.3	39.8	69.6	35.3	62.4	29.1
Not Tenured	25.6	50.2	30.4	64.7	37.6	70.9
• In tenure track	52.7	42.1	75.8	82.0	72.9	84.8
• Not in tenure track	47.3	57.9	24.2	18.0	27.1	15.2

NOTES: N's are weighted. Table omits responses to the Survey of Doctorate Recipients that did not indicate gender or tenure status. Tenure-track status was not a question on the Survey of Doctorate Recipients prior to 1981.
SOURCE: National Research Council, Surveys of Doctorate Recipients.

ACADEMIC RANK

The fourth career outcome examined here is academic rank (see Table 4). Male S&E faculty overall, and male engineering faculty in particular, are more likely to be full professors than are women. Overall in the sciences and engineering, there were increases for both women and men, in the percentages who were full professors during the 17-year period, 1973-1989. However, between 1989 and 1995, the percentage of men who had achieved this rank declined, to just 2.6 percentage-points more than in 1973. During this latter period, the percentage of female S&E faculty who were full professors also decreased, but by less than 1 percentage-point. That may look good at first. However, note that the gender gap in 1995 among full professors was basically unchanged since 1973—about 21 percentage-points.

At first, the trends in academic rank in engineering appear similar to those for all sciences and engineering combined, for the percentage of male engineering faculty who were full professors did increase between 1973 and 1989—by about 8 percentage-points. However, achieving full professorships in engineering is quite dissimilar from what happened in science and engineering overall during the 1989-1995 period in two distinct ways:

1. Higher percentages of men continued to hold full professorships in engineering; by 1995, about 50 percent of male engineering Ph.D.s were full professors.
2. In contrast, the percentage of female engineering faculty who were full professors declined by almost 3.5 percentage-points between 1989 and 1995 after having risen by more than 6 percentage-points between 1973 and 1989.

As a result, there was a widening of the gender gap among engineering faculty who were full professors—from a difference of 31.4 percentage-points favoring men in 1973 to one of 37.9 percentage-points in 1995, again favoring men.

TABLE 4: Academic Rank of Ph.D. Scientists and Engineers at U.S. Universities and 4-Year Colleges, in 1977, 1989, and 1995, by Sex

Academic Rank	1973		1989		1995	
	Male	Female	Male	Female	Male	Female
All S&E						
Full professor	36.3	15.4	46.6	17.9	38.9	17.2
Associate professor	27.9	22.5	23.8	25.1	23.1	22.3
Assistant professor	21.3	36.2	16.3	30.2	17.1	28.0
Instructor	7.1	16.6	0.6	2.0	1.8	5.0
Other*	7.4	9.3	12.7	24.8	19.2	27.2
Engineering						
Full professor	39.6	8.2	47.3	14.3	49.8	11.9
Associate professor	33.4	40.8	26.6	22.7	24.1	21.7
Assistant professor	21.5	38.8	16.1	48.7	19.0	48.3
Instructor	0.2	0	0.7	0	0.2	2.3
Other*	5.4	12.2	9.3	14.3	6.8	15.8

* "Other" includes lecturers, adjunct professors, and others not listed above.
NOTES: N's are weighted. Table includes only individuals who indicated that they were employed either full-time or part-time. Table omits responses from the Survey of Doctorate Recipients that did not indicate gender or academic rank.
SOURCE: National Research Council, Surveys of Doctorate Recipients.

CONCLUSION

These few pages present only a few descriptive statistics showing how the participation and success rates for female engineering faculty are lower than those of their male counterparts. During the formal presentation, additional information will be provided.