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ABSTRACT

Women are underrepresented in professional and technical careers. Research to examine this imbalance has focused on either characteristics of individual women or the interpersonal and structural barriers faced in pursuing these careers. An integration of both person and setting perspectives may provide further understanding of traditionally male-dominated fields, particularly engineering, which may have the most extreme ratio of males to females. Male and female undergraduates (N=191) participated in interviews exploring demographics, high school experiences, college and career plans, perceptions of engineering, experiences of sex discrimination, and other related topics. Results indicated that women did not differ significantly from men in ability or career motivation. However, the women engineers were subject to many interpersonal and social barriers to their choice of engineering, e.g., social isolation, family and career commitments, negative critical incidents, and sex discrimination. Characteristics of the women engineering students paralleled those found in other studies: the women were autonomous and capable, despite existing obstacles. (Author/NRB)

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Women Students In Engineering: A Case Study

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Women Students in Engineering: A Case Study

It has commonly been observed that women are underrepresented in professional and technical careers. Recently, there has been an effort to understand and redress this imbalance. Research has focused on two principal ideas: first, that characteristics of women themselves are primarily responsible (e.g., Horner, 1972); and second, that interpersonal and structural barriers are largely to blame for the lack of women in high status careers (Zellman, 1976; Levitin, Quinn and Staines, 1971; O'Leary, 1974; Darley, 1976). The first explanation can lead to "blaming the victim" (Condry and Dyer, 1976), while the second is more amenable to "system blame" (Caplan and Nelson, 1973). Perhaps the most sensible view is one which looks at both person and setting and integrates both perspectives (Roby, 1972), as the current move toward interactionism in personality theory suggests.

Other studies have taken a more positive approach to the question and looked at women who have overcome the obstacles. For instance, Tangri (1972) has examined the background and personality characteristics of college women who were occupational "role innovators," pursuing traditionally male careers. In 1973, Kundsin edited a book titled Women and Success: The Anatomy of Achievement, which focuses on women in science.

Of all the traditionally male-dominated fields, engineering may have been the most extreme in the ratio of males to females. In 1960, women constituted fewer than one percent of all engineers (Robin, 1969). Only in the last several years has the percentage of women choosing engineering increased. Holmstrom (Note 1) has reported that some 4,100 women, seven percent of the total, entered American engineering schools in 1974. By 1979, approximately nine percent of the bachelor's degrees in engineering were awarded to women (Sheridan, 1980). Clearly, the absolute numbers of women choosing engineering are still low, despite recent increases.

In the present paper, the two types of "explanations" (noted above) for the low incidence of women in engineering will be examined both in recent literature and in data from a sample of 191 women and men college students, half of whom were in engineering. Some factors facilitating the choice of engineering for women, or associated with those who make the choice, will also be examined.[1]

Explanation #1: "Characteristics of women's ability and motivation explain the low percentage of women in engineering."

Sex differences in mathematics and spatial relations ability are well-documented. On the other hand, the actual size

[1] Though the empirical data reported here were collected in the fall of 1975, they should still be of interest to researchers concerned with the entry of women into nontraditional fields. First, the study involved intensive interviewing (vs. the large scale survey methodology in other studies performed around the same time). Second, in an area of (at least apparently) rapid social change, it is useful to have a clear delineation of where matters stood, at a particular point in time. Third, the present study allows a basis from which to replicate and extend the scope of the research, as will be detailed at the end of this paper.

of those differences is quite small. Sherman (1978) estimates that gender differences in spatial ability account for four percent of the variance in spatial ability. Clearly, such a difference does not adequately account for the nearly complete absence of women in engineering. A sex difference in analytical ability may also be ruled out as an explanation, since Hyde and Rosenberg (1976) concluded from reviewing the literature that there is no overall sex difference. Hoffman and Maier (1966) demonstrated that problem-solving ability in women is affected by the situational context, type of problem content, etc. These studies as well as data indicating the high academic qualifications of women entrants into engineering curricula (Holmstrom, Note 1) suggest that in the present sample, women engineering students will be at least as capable as the men.

The lack of women in male-dominated fields has often been attributed to women's purported "motive to avoid success" (Horner, 1972). However, sex differences in this motive have by no means always been replicated. This research has been criticized on both conceptual and methodological grounds (Tresemer, 1974; Condry and Dyer, 1976; Smith, 1976). A more recent interpretation suggests that the "motive to avoid success" might best be interpreted as a "fear of gender-inappropriate behavior" (Cherry and Deaux, 1978). In any event, a "motive to avoid success" does not seem adequate by itself to explain the dearth of women in engineering, and this factor will not be assessed directly in the present study.

It has also been claimed that women's career motivations differ from men's--that they may be less persistent in pursuit of their career, or less satisfied by it, for instance. Among students who have made a commitment to engineering, however, there is less reason to expect large sex differences in career motivation. On the other hand, the anticipated difficulties or fears for people entering engineering are more likely to differ between the sexes, since women are still such a minority.

Explanation #2: "Women encounter interpersonal, social, and institutional barriers which block the choice of engineering or make that choice more difficult."

The Proceedings of a conference titled "Women in Engineering...Beyond Recruitment" (Ott and Reese, Note 2) suggest many possible factors relevant to this "explanation." Among those to be explored here are attempts to dissuade women from entering engineering, social isolation, perceived family versus career conflicts, and widespread perceptions of the difficulty of the field for women. In the present sample, it is predicted that more situational and interpersonal barriers to being in engineering will be perceived and experienced by the women students, relative to the men.

Factors Facilitating the Choice of Engineering for Women

Ott (Note 3) found a number of background factors which characterized her large sample of freshman women engineering students: high academic achievement; a perception that faculty expected superior performance from women; and broader outside interests. Holmstrom (Note 1) and Schneider-Robinson (Note 4) found that women engineers, more than other students, had fathers who were engineers, suggesting that fathers may function as role models, making engineering seem both visible and accessible to women who might not otherwise think of it. In addition, there was a trend in both Holmstrom's data and Ott's (Note 3) for women engineers' mothers to be better educated. Other studies (e.g., Baruch, 1972) lead to a prediction that there will be a higher rate of maternal employment among the women engineers than among others. Finally, the personal qualities found to characterize role innovators (Tangri, 1972; Lemkau, 1979)--autonomy, individualism, etc., should characterize this sample of women engineering students.

Method

Subjects. One hundred ninety-one students participated in the study (46 male engineers, 49 female engineers, 50 male nonengineers, 46 female nonengineers). All students attended one eastern university which has three undergraduate colleges--Engineering, Arts and Science, and Business. Women comprised approximately 22% of the undergraduate enrollment and were concentrated in the Arts College; however, their numbers have been increasing in both Engineering and Business. Between 1974 and 1976 the percentage of women students in Engineering increased from 5.7% to 12.5% and the percentage of women in Business increased from 11.4% to 20%. The data in the present study were collected in the fall of 1975.

Subjects were chosen randomly, with an intended number of 12 in each of 16 cells (freshman through senior, male and female, engineering and nonengineering). The achieved sample per cell ranged from 8 (senior women engineers, of whom there were few) to 16 (junior women engineers were deliberately oversampled to make up for the lack of senior women engineers). In addition, the official listing of a student's class year, in terms of credit hours, did not always agree with the student's perception of it; some students claimed a different class year than that listed on the rosters from which the sample was drawn.

Procedure. The study was carried out in the context of an undergraduate, interdisciplinary seminar titled "Women in Engineering."[2] After a training and practice period, eight of the twelve female students in the seminar conducted structured face-to-face interviews, at a place of the subject's choosing. Subjects were assigned to interviewers randomly with two restrictions: a close friend of an interviewer was reassigned to another interviewer; and engineering students did not interview other engineering students. Subjects were

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[2] I am indebted to the other faculty members (Laura Olson, Sharon Friedman, and Lora Liss) and the student members of the seminar (especially Martha Hutton and Carol Richardi) for making this paper possible. Collectively, we are indebted to Lehigh University's Humanities' Perspectives on Technology Program (now the Program in Science, Technology, and Society) for supporting the seminar and underwriting some of the expenses of this research.

recruited via a letter and telephone call; the refusal rate was very low.

The interview consisted of 123 questions covering the following areas: demographic information; high school experiences; college major and career plans; perceptions of engineering and of engineering students (especially women); experiences of sex discrimination (if any); and a number of related topics. The interview session took between 45 and 75 minutes, and all interviews were completed in the fall semester of 1975.

Results

The findings to be reported below will be presented in three groups, paralleling the three approaches to understanding the situation of women in engineering which were outlined above. All variables, even those which could have been used as ordinal or interval scale data (e.g., age, SAT scores) were divided into categories for use in analyses. In all cases, the results involved comparisons among male engineers, female engineers, male nonengineers, and female nonengineers (i.e., Arts College and Business students) unless otherwise stated.

Explanation #1: Differences in Ability and Motivation

The first set of results concerns ability differences (if any) between males and females.

1) There were no differences among the four groups in reported verbal SAT scores. There was a trend toward higher scores among the women vs. the men, but it was not statistically significant.

2) There was a substantial difference among the groups in reported SAT scores in mathematics: $X^2(9) = 30.87$, $p < .001$, $N = 188$. This difference reflected primarily the effect of the two curricula; engineering students had higher scores. Among the engineers there was no sex difference in mathematical SAT scores at all. There was a trend toward higher scores for men vs. women among the nonengineers: $X^2(3) = 5.35$, $p < .10$, $N = 94$. Not surprisingly, the groups also differed in the number of semesters of mathematics taken in high school; again, the major difference appeared to be due to curriculum and not to sex: $X^2(6) = 17.08$, $p < .01$, $N = 191$. At the same time, there were no significant differences in the number of science courses taken in high school.

3) With respect to high school rank in class, there was also a difference among the four groups: $X^2(9) = 21.54$, $p < .025$, $N = 185$. The women reported higher ranks, and there seemed to be little difference between the two curricula.

4) Sophomores, juniors, and seniors were asked to report their college grade point average (GPA). (Since the study was conducted during the fall term, freshmen had not yet received their first semester grades.) The groups differed in GPA: $X^2(12) = 31.17$, $p < .002$, $N = 142$. In general, women had higher grades than men, though the number of engineers, both male and female, at the lower levels (GPA below 2.5) was greater than would be expected by chance.

The second set of findings concerns differences (if any) among the four groups in motivation.

1) More women (in both curricula), relative to the men, reported that they derived greater satisfaction from school than from spare time activities. The difference was highly significant: $X^2(3) = 11.88$, $p < .01$, $N = 173$. (Subjects answering "both ($N = 3$) or "don't know" ($N = 15$) were eliminated from this analysis, since there were very few of them and their retention would have resulted in many cells whose expected frequencies were less than five.)

2) Students were asked what they most expected from their college education: exposure to new ideas, career preparation, attainment of a degree, opportunity for a good social life, or satisfaction of parental expectations. Since only three people endorsed the last two categories, they were eliminated from the analysis. "Career preparation" accounted for a total of 63.3% of the responses. Relative to what would be expected by chance, career preparation was especially likely to be chosen by engineering students (both male and female), while "exposure to new ideas" was more important to the nonengineers. The overall distribution was statistically significant: $X^2(6) = 20.66$, $p < .005$, $N = 188$.

3) There were no significant differences among the groups in satisfaction with one's chosen field of study.

4) As an index of persistence in their chosen field, subjects were asked how low their GPA would have to go before they would consider switching majors. There were no significant differences among the four groups.

5) When the engineering students were asked to describe their "greatest fear" in becoming an engineer, they gave a great variety of responses, but 81 of the 94 answers could be grouped into three categories: lack of personal qualifications (not getting through school, not being qualified for engineering, or failing on the job); situational factors (lack of good jobs, finding the work boring); or denial of any fears. The women engineering students tended to report more fears concerning their own qualifications while the men were somewhat more inclined to deny any fears ($X^2(2) = 5.56$, $p < .10$, $N = 81$). Five women mentioned a fear of dealing with the men in engineering and one explicitly mentioned threats to her femininity.

Explanation #2: Interpersonal, Social, and Institutional Barriers

1) Students were asked if they felt any social isolation, both from members of the same sex and from members of the opposite sex. Women, especially the engineers, reported more same-sex isolation than did men: $X^2(3) = 11.67$, $p < .01$, $N = 191$. Despite being surrounded by men, 24.5% of the women in engineering reported isolation from males, while only 8.7% of the nonengineering women did so. Approximately 50% of the men in both curricula reported isolation from women, and these differences are highly significant: $X^2(3) = 29.61$, $p < .001$, $N = 191$.

There is another possible source of social isolation for women. Respondents were asked to state whether they felt uncomfortable about dating someone whose grades were higher or lower than their own. Almost two-thirds of the subjects expressed no discomfort at dating someone with different grades, but women were much more likely than men to express discomfort with dating someone who has lower grades: $X^2(9) = X^2 20.48$, $p < .005$, $N = 190$.

2) There was evidence of differing expectations for future family and career commitment. Males were significantly less positive than females about a potential spouse who would be strongly committed to a career: $X^2(12) = 30.23$, $p < .003$, $N = 190$. Males, especially the nonengineers, were also much less happy about a future family arrangement in which both spouses were employed and shared the housework equally: $X^2(12) = 32.63$, $p < .002$, $N = 190$. It is worth noting that only 31.6% of the subjects (with no significant differences across the groups) felt that the age of a woman's children should not affect her decision about whether to work full time. (This is in spite of the fact that 50% of the women engineers and 58.7% of the women nonengineers hope to marry, work full time, and have children in the future. For males, these same percentages are 84.8% and 62% for engineers and nonengineers, respectively.) As a possible response to this judgment, 11 women engineers, almost twice as many as any other group, are planning to marry, work full time, and have no children.

3) There were over three times as many reported efforts by others to dissuade women engineering students from entering engineering (19) than for men engineering students (6): $X^2(1) = 7.45$, $p < .01$, $N = 93$.

4) Subjects were asked to describe critical incidents (if any), both positive and negative, which affected their decision to stay in or contemplate leaving their major field. Positive and negative incidents were recorded in the same general categories. Ninety students reported specific positive incidents, and the most common ones were: specific courses (27.8%); job experiences (21.1%); specific teachers (17.8%); the job market (11.1%); and grades (10%). Of the 80 reported negative incidents, the most common ones were: grades (31.3%); specific teachers (22.5%); and specific courses (20%). There was a trend for women in both curricula to give more positive incidents than the men: $X^2(3) = 6.91$, $p < .10$, $N = 171$. For negative critical incidents, the X^2 across the four groups was not significant. However, women in engineering were the only group in which a majority ([illegible]) reported negative incidents. They were the most different from the nonengineering women students, only 35.1% of whom reported negative incidents. The difference in negative incidents reported for the two groups of women alone was significant: $X^2(1) = 4.09$, $p < .05$, $N = 86$.

5) Female respondents were asked if they had experienced sex discrimination: overt, covert, or both. A total of 48.4%

of the female students reported instances of sex discrimination from male faculty (with no significant differences between engineers and nonengineers). Of the women, 88.4% had experienced no sex discrimination from women faculty. while 9.5% experienced covert discrimination and 2.1% more experienced both overt and covert discrimination. Most of these instances (9 out of 11) were reported by nonengineering students (probably because they have been in more classes with female faculty members). Male students were the most common source of sex discrimination: 71.6% of the women reported such discrimination. By contrast, 20% experienced sex discrimination from female students. For 28% of the women, male lab partners were reported to have evidenced sex discrimination. In only three cases was any sex discrimination from a female lab partner reported. There were no significant differences between engineering and nonengineering women in reports of sex discrimination from either fellow students or from lab partners. Examples of sex discrimination were varied, with being singled out as a woman and having one's competence doubted by a male student the two most frequently occurring ones.

6) In several different ways, participants recognized some potential or real problems for women in careers generally and in engineering in particular. Briefly summarized, these findings are as follows:

a) Of the whole sample, 64.9% thought that there were barriers to women's employment other than women's own skills.

There were no significant differences across groups in this perception. Reasons cited included sex-role stereotyping (40.3%), job discrimination (34.7%), and home vs. career conflicts (16.9%).

b) Almost half the sample (42.9%) felt that women would have difficulty as practicing engineers. There were no significant differences across the groups. Three difficulties for women engineers accounted for 67.5% of those cited by participants: not being taken seriously, not being accepted, and having problems with male domination of the field.

c) Of the engineering students, 40.9% thought that women would have to work harder than men to advance in the field; there were no significant sex differences in this perception. This finding is not surprising in view of the fact that 57.1% of the respondents felt that there is discrimination against women in engineering: 49.1% felt that the discrimination is greater than in other professions, while only 7.3% felt that it is less.

d) Ten men and four women among the engineering students thought that there are certain fields in engineering which women shouldn't enter: $X^2(1) = 3.50$, $\underline{p} < .10$, $\underline{N} = 93$.

e) The engineering students were asked if they would prefer a man or woman for a lab partner. Of those who expressed a preference, 20 of 22 choices were for a man (two male students expressed a preference for a female lab partner).

f) Among women, 53.2% thought that women are not now given equal pay for equal work; 40.4% thought that women do get qual pay, while 6.4% didn't know. There were no significant differences between the engineers and nonengineers.

7) In view of all the findings cited under #6, above, it may be surprising to note that the women engineering students were quite sanguine about their future prospects. Overall, engineers, especially women, saw job prospects in their chosen field as good or very good; the nonengineers were less optimistic: $X^2(15) = 62.30$, $p < .001$, $N = 171$. (Only students who had chosen a major were asked this question.) Students were also asked whether job prospects for women vs. men in their chosen field were the same, better, or worse. The women engineers were by far the most inclined to think that women's job prospects in their own chosen career were better than men's (45 out of 49). Interestingly, the only respondents who felt that women had worse job prospects were men (eight engineers and nine nonengineers): $X^2(9) = 45.29$, $p < .001$, $N = 171$. (There are some missing data in these analyses since not all respondents had chosen a career.) Finally, of the 113 subjects who were aware of Federal Affirmative Action laws, the women (not surprisingly) were far more likely to think that the laws would benefit them; this was most true of the women in engineering. Eleven male engineers and eight male nonengineers felt that their own job prospects would be decreased. This pattern of responses was highly significant: $X^2(6) = 69.83$, $p < .001$, $N = 113$.

Factors Facilitating the Cnoice of Engineering for Women

Family Background. 1) Students were asked if they knew any practicing engineers (excluding faculty) and, if so, whether one or more of them was a relative. Of those who had a relative who was an engineer, a higher proportion of women engineering students had fathers who were engineers: $X^2(3) = 8.28$, $p < .05$, $N = 86$. There were no differences in the incidence of other relatives (brother, uncle, mother, or sister) who were engineers.

2) In the whole sample, 51.1% had mothers who were employed at least some of the time before the respondent went to college. Of these, 46.7% of the mothers worked full time, 42.4% worked part time, and 10.9% worked on a sporadic schedule or had worked both part and full time. There were no significant differences across the groups in the incidence of maternal employment. However, there was a sharp difference in the age of the respondent when the mother first went to work; the great majority of the women engineers whose mothers worked were under 12 when their mothers started working. The reverse was true for the male students (both engineers and nonengineers). All but nine of the 37 respondents whose mothers worked when their child was less than six years old were women. This distribution was highly statistically significant: $X^2(9) = 30.90$, $p < .001$, $N = 95$.

3) The families of engineering students had lower incomes than those of nonengineers: $X^2(6) = 18.97$, $p < .005$, $N = 178$.

The largest difference appeared to be between the two groups of women students. There were no differences in educational level for either mothers or fathers; however, there was a difference in the occupational level of the fathers. Though only 32 of the fathers worked in blue collar jobs, the majority of them were fathers of engineering students: $X^2(3) = 11.75$, $p < .025$, $N = 190$.

4) There were no differences across the groups in either birth order or the number of brothers or sisters.

<u>School Factors</u>. 1) Engineering students were asked whether faculty members had higher expectations of male or female students. Seventy-one percent felt that there were no differences in faculty expectations, and there were no differences across the groups. Approximately 11% felt that faculty expectations for women were higher, but the same number felt the opposite.

2) More than any other group, women engineering students were influenced in their choice of school by the availability of financial aid: $X^2(3) = 14.81$, $p < .003$, $N = 190$. Women engineers were most likely, and the women nonengineers least likely, to be among the 51.1% from the total group who had applied for financial aid: $X^2(3) = 9.89$, $p < .02$, $N = 190$. These findings are not surprising in view of the information concerning family income level described above.

Personal Characteristics. 1) The high achievement level of women engineering students has been reported above.

2) Women students were asked to characterize their support for feminism on a five point scale from "not at all" to "very much." Fifty percent of the sample rated themselves "moderate," but overall the women engineers characterized themselves as more feminist: $X^2(4) = 10.54$, $p < .05$, $N = 94$.

3) Respondents were asked to pick three out of a list of adjectives with which to describe women engineering students. "Independent" was by far the most frequently endorsed item. "Adaptable," "reliable," and "aggressive" were also chosen often. There was a striking pattern in the response to "aggressive." Only 19.6% of the male engineers chose that word to describe women engineers, while 58% of the male nonengineers did; the groups of women were between the two extremes. These differences were highly significant: $X^2(3) = 18.19$, $p < .001$, $N = 191$. Women engineers were also much more likely than the other groups to perceive women engineers as adaptable: $X^2(3) = 12.69$, $p < .01$, $N = 191$.

Discussion

The data concerning ability differences (Explanation #1) tend to indicate that, if anything, the women engineering students are better qualified than the men; at least this conclusion is warranted with respect to the individual school studied. However, it is also consistent with other studies

(Ott, Note 3). Particularly striking is the absence of sex differences in SAT mathematics scores among the engineers. Despite what may be a general sex difference in this area, only well-qualified women are choosing engineering and being admitted to the curriculum in the college studied. Even among the nonengineers in this sample, the SAT mathematics scores for males and females did not significantly differ. Apparently, there are at least some other women students who would be qualified to enter engineering curricula if they chose to do so and received some encouragement.

With respect to motivation (Explanation #1) the general pattern is a lack of sex differences within curriculum. Both groups of engineering students place a great emphasis on career preparation as a reason for attending college and there is no difference across the four groups in willingness to persist in, or satisfaction with, one's major. In fact, the women (in both curricula) may be more serious about their work, since they report greater satisfaction from their school vs. spare time activities. (An alternative explanation, which cannot be ruled out, is that women in this highly male-dominated college find the available spare time activities relatively unsatisfying, and thus concentrate more on studying.)

In view of the high qualifications of women engineering students, it is interesting to note that their fears about entering engineering tend to revolve more around a lack of personal qualifications, whereas the men are more likely to deny any fears. It is evident that, at some level, some of these women have "bought" the societal image of female incompetence in matters scientific and technical and are paying a price in self-blaming anxiety. That there are internal contradictions is shown when one compares this anxiety to the women's perceptions of a job market waiting eagerly to receive them.

Evidence concerning interpersonal barriers to women in general and women engineers in particular (Explanation #2) abounds in these data. Women, who are a minority at the school studied, experience considerable same sex social isolation; almost 25% of the women engineers, despite their nearly all-male environment, also experience social isolation from the opposite sex. One may assume that women's discomfort in dating a person with lower grades combined with their own higher grades does not help their social situation. Furthermore, the women's wishes about future home and career commitments would appear to conflict with those of the men they are most likely to meet and wish to marry. Their desire for a spouse with a strong career commitment is not matched by the men's, and the men are not thrilled at the possible prospect of sharing housework and career commitments equally. The majority of the women want to marry, work full time, and have children; yet, over two thirds of the sample also would place some restrictions on a woman's working outside the home when her children are young. Altogether, it is clear that these women and men will be required to negotiate to find mutually agreeable patterns of living.

Women engineers have experienced more efforts to dissuade them from entering the field than men have; this is a particularly clear sort of "interpersonal barrier." At the same time, the women engineers were more likely than any other group to describe negative critical incidents. By contrast, the women, both engineers and nonengineers, report somewhat more positive incidents. Possibly, the women are somewhat more articulate in describing their experiences altogether, or maybe they really do have more strong positive and negative experiences, given their "minority" status.

The data in this study also yield much evidence of social and institutional barriers to women (Explanation #2). The women, both engineers and nonengineers, report high levels of overt or covert sex discrimination (or both), especially from their male peers and from male faculty. Despite the high capability of women students in this sample, almost all males and all females who expressed a preference would choose a male partner for laboratory work.

For women who do enter engineering, there are widespread perceptions that women should not enter certain fields. As well, most subjects (male and female alike) perceived various career barriers for women: difficulties for women in practicing engineering, the necessity for women to work harder than men to advance, job discrimination, sex-role stereotyping, home vs. career conflicts, etc. Finally, over half of the women recognized the current reality of unequal pay for equal work

(Levitin, et al., 1971). Many of the barriers (both interpersonal and social) documented here are consistent with those discussed by Ott and Reese (Note 2).

Again, given the rather grim picture outlined above, it is remarkable how optimistic concerning their future prospects the women engineers are. It is as if they were saying, "I see how bad things are in general, but for me they will be fine." How long they will be able to maintain this optimism is unclear. (That college students currently maintain a rosy view of their own vs. society's future is documented by Levine, 1981.)

Certain family background factors were found to characterize the engineers, and especially the women. As in Holmstrom's data (Note 1), the women engineers had fathers who were engineers. Fathers are apparently an important role model for these women, even more so than for the male engineers. Several of the other factors are interrelated. The fact that the women engineers' mothers who worked were more likely to do so before the respondent was 12 years old is no doubt related to the fact that the engineers' fathers worked in lower-status jobs and made less money. Yet this pattern of early maternal employment was stronger for the women engineers than for the men. A child whose mother is working outside the home must necessarily develop his or her own resources and may well be more independent than a child whose mother is not employed. This effect may be particularly strong for girls, who may not otherwise be socialized to be independent. Thus, it is understandable that the great majority of the sample described women engineers as "independent." Unlike Holmstrom (Note 1) and Ott (Note 3), this study did not indicate that the women engineers' mothers were better educated or overall more likely to be employed outside the home. However, it is worth noting again that even in this middle- and upper-class sample (64% of the family incomes were $20,000 or more), 51.1% of the mothers had been employed at some time before the respondent went to college.

Given the information about family income level, it is not surprising that the availability of financial aid influenced women engineers' choice of school. If this pattern is not peculiar to this specific sample, it has clear implications for anybody who would like to see more women have the opportunity to enter engineering. This is one changeable institutional barrier.

Ott (Note 3) found that students perceived faculty expectations for women's academic performance to be higher than for men's. This finding was not replicated in the present study. Since these data were collected later than Ott's, as well as at a different school, either cohort differences or sample differences could account for the nonreplication.

The personal characteristics of the women engineers are consistent with those found in other studies. The high level of academic achievement which Ott (Note 3) found is also seen here. In addition, the engineers are similar in a number of respects to Tangri's (1972) "role innovators" and to the portrait of women in nontraditional careers which emerges from Lemkau's

(1979) review of the literature. They were described by themselves and by others as "independent," "adaptable," "reliable," and "aggressive." These, in addition to expressing support for feminism, are not viewed as traditionally "feminine" characteristics, but the first three are all desirable qualities in any adult. (In this context it is interesting to note that there was no difference in the degree to which the women engineers vs. the women nonengineers saw themselves as "feminine." Perhaps the women engineers are somewhat defensively reassuring themselves that they really are "ok"; or perhaps there really is no necessary inconsistency between femininity and competence.)

The perception of women engineers as "aggressive" seems to be a clear instance of stereotyping. The male engineers (who presumably have interacted with the women in class and elsewhere) were quite unlikely to use that adjective, whereas the male nonengineers (who probably know less about women engineering students than any other group) were very likely to endorse that adjective as descriptive of women engineers. This finding simultaneously illustrates the degree of stereotyping women engineering students must confront and provides hope that the stereotyping can be overcome with experience.

Of the two "explanations" for the lack of women in engineering which have been reviewed, the second -- interpersonal, social, and institutional barriers -- is the more compelling in these data. Yet, as is well known and has been illustrated here, "external" barriers can have internal consequences --

e.g., the women engineering students' worries concerning their personal qualifications for their chosen career. It would seem that as of 1975 only the most persistent and capable women were choosing engineering in the first place, a pattern that may change as the option begins to appear open to more women. At the time, however, women engineering students were distinguished by their ability, persistence, and optimism in the face of many obstacles to their success.

<u>Limitations to Generalizability and Implications for Future Research</u>

In this study a number of findings consistent with previous research have been reported. At the same time, one must be cautious concerning the generalizability of these findings. To begin with, the students were all attending one relatively prestigious private, eastern university in which Engineering was the largest of the three colleges. Students were overwhelmingly white, native born, and drawn from the three states contiguous to the university's location. Another limitation concerns the time of the study; data were originally collected in the fall of 1975. As the percentage of women in engineering has been continuing to increase, it is reasonable to expect that certain findings might no longer occur as women entering engineering are less "deviant."

The limitations just cited leave one unable to deconfound the effects of a particular institutional context and the social conditions of a particular time period from other effects of interest. The author's current research (sponsored by the National Institute of Education, NIE-C-79-0115) represents an attempt to overcome both limitations noted above by including six widely varying institutions in the sample and restudying the university described here after a period of four and one-half years. That research will allow a direct test of the generalizability (across both institutions and time) of many of the findings described in the present report.

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