So this teacher came down from the high school to give a demonstration in physics and said, 'Now this is going to make a pretty big noise, so any of you girls who don't like loud noises better cover your ears.'

He said, 'Now this is going to be dirty so we'd better have a boy do it.'

And he (a high school science teacher performing a demonstration to a sixth-grade class) said, 'Now this will help you boys who fix your own bicycles, so pay attention!'

(See also [Marriott 1991] and [Hall 1982].) The girls then go on to describe the difficulties they had in getting their parents to buy them tinker toys and chemistry sets, which are routinely bought for their brothers [Casserly 1979, page 9].

1.2 Ways that Males and Females are Treated Differently

In addition to the people who consciously believe women less capable, there are those who acknowledge that women can succeed at engineering but consider female engineers to be "somehow suspect" [Turkle 1984, page 200]. I will examine several aspects of this problem: First, based on their preconceptions of women, people often exhibit subtle forms of subconscious bias that cause them to treat women differently from men. Second, men and women are often held to different standards. Strange as it sounds, behaviors — such as succeeding — are sometimes considered attractive in men but not in women. Third, there is something about our culture's view of male-dominated fields such as engineering that causes female aspirants to be considered unattractive.

1.2.1 Subtle Bias

In [Sandler 1986, Sandler 1988, Hall 1982], there are summaries of several studies of subtle, subconscious bias — that is, people observably acting in a biased manner but unaware of their doing so. I was apprised of the importance of subtle bias by the number of respondents who objected to my call for "egregious examples", writing that they thought the subtle behavior to be more damaging. [Hall 1982, Sandler 1988] report the following biases, of which both men and women are guilty:

- Women are interrupted more than men.
- Faculty members make eye contact with male students more often than with female students.

- Faculty members are more likely to know and use the names of their male students than of female students.[6]

- Women are often asked fewer or easier questions than males.

As Sandler writes, "Singly, these behaviors probably have little effect. But when they occur again and again, they give a powerful message to women: they are not as worthwhile as men nor are they expected to participate fully in class, in college, or in life at large" [Sandler 1988, page 149]. Unfortunately, the message appears to have sunk in. Studies have shown that, when engineering students are asked to predict the academic performance relative to that of male and female colleagues, "both sexes anticipated that men would outperform women. This was paradoxical, since the average female student had both a higher grade point average and higher class rank from high school than the average male" ([Ott 1975] in [Zappert et al 1984, page 4]). Another study found that, when male and female college students were asked to predict their midterm test score before taking it, men had higher expectations for themselves than women did for themselves, even though the two groups actually performed the same [Erkut 1983, page 229]. Studies have found that women are more likely than men to attribute success to luck instead of skill [Deaux et al 1974] and to attribute failure to lack of skill [Ernest 1976, page 599]. Women's lack of confidence, and one consequence, is illustrated by an incident at Columbia, reported by Professor Joan Birman:

> I learned last year, to my astonishment, that for about four years running the honors calculus course had been all male, in spite of the fact that admission was based on an open competitive examination. This fall, one of the senior mathematics majors and myself made an intensive effort to encourage women to *try the exam!* The typical answer was, 'I know I won't pass it,' — to which we replied over and over, 'Well , if you try it, at worst you will confirm what you already know, and only an hour of time will have been lost.' After three days of such advising, the big day came, the exam was given, and this year the class has five men and five women! [Ernest 1976, page 604].

Not surprisingly, girls at single-sex schools study physical science and math more than in comparable coed schools, "even though girls' schools frequently have less adequate laboratory provision than mixed schools" [Kelly 1982, page 497]

Even more ominously, [Sandler 1986, page 6] reports:

> In one study, first done in 1968 and then replicated in 1983, college students were asked to rate identical articles according to specific

[6] The experience of women I have talked with is that if females are in an extreme minority, they stand out so much that the teachers are likely to know their names.

> criteria. The authors' names attached to the articles were clearly male or female, but were reversed for each group of raters: what one group thought had been written by a male, the second group thought had been written by a female, and vice versa. Articles supposedly written by women were consistently ranked lower than when the very same articles were thought to have been written by a male [Goldberg 1968, Paludi et al 1985, Paludi et al 1983]. In a similar study, department chairs were asked to make hypothetical hiring decisions and to assign faculty rank on the basis of vita. For vitae with male names, chairs recommended the rank of associate professor; however, the identical vita with a female name merited only the rank of assistant professor [Fidell 1975].

Anti-female bias is strongest in traditionally male fields [Top 1991, pages 96–97].

When discussing the results of such studies with fellow students, I found that the males have tended to be more surprised than the females, because many females recalled specific instances of biased behavior, several categories of which are represented below.

In some cases, a woman was viewed as less serious than a man in a similar position:

- A female computer science graduate student had the following experience:

  > I was working at a fairly small company whose communal coffee was *awful*. A group of 6 of us (4 men, 2 women) bought our own coffee maker and had decent coffee which we paid a few cents for to defray the costs of coffee and cream. Anyway, I usually bought the coffee and my male coworker usually bought the cream. A new member to the group (male) approached me and told me we were out of cream. I told him that M2 usually bought the cream. Later that same day, M1 again comes up and tells me we are out of cream. I once again tell him that M2 gets the cream. To this he says, 'But how can I bother M2 with something as insignificant as buying cream?' Needless to say, I told this fellow exactly what I thought about that...

- One female graduate student in mechanical engineering sent the following two stories:

  1. When I first started the [graduate] program, the head of the department (male) was assigning desks to graduate students... ([T]here were two entering females to the particular program at that time.) As he ran out of desks, he said, 'Well, just put the girls together on a desk.'
  2. That same professor put me (a newly graduated math major) into the slower (undergraduate) statistics class, and put a guy who had had

a vague introduction to stats 8 years earlier in the faster (graduate) class.

Both events took place in the past two years, a time period which she has found "very frustrating".

- A female computer consultant wrote:

  > Most of our users ask for and accept help from whichever consultant is available, but some insist on talking with one of the male consultants (only 2 of the 10 consultants are male). One user persisted at this, even after Alan explained to her that he didn't know the package she was working with, and that she would be better off asking me because I specialize in that particular software. Another user did ask me her question, but when she didn't like the answer I gave her (I explained what she could not do and why), she insisted on taking her problem to David (a higher authority?), who proceeded to tell her exactly what I had just explained. What is interesting about the latter incident was that she did not seem to be after a second opinion, because she could have gotten that from a number of people (all female). She apparently specifically wanted a male opinion.

- When a female computer science undergraduate visited one of the graduate schools to which she had been admitted, she and a male prospective student met with a male graduate student to discuss the school. Whenever the woman asked a question, the graduate student directed his answer to the male prospective instead of to her, i.e. by making eye contact and gestures toward the male prospective. This treatment surprised the woman, as she had not encountered such behavior at her undergraduate institution. After the meeting, she delicately pointed out the behavior to the graduate student, and he apologized profusely and sincerely, clearly unaware of the bias while it was occurring. When they met later in the day, his behavior was markedly better. The same woman, however, in a later meeting with two other graduate students, one male and one female, found herself addressing most of her questions to the male until she recognized her behavior and corrected it.

1.2.2 Different Expectations for Men and Women

The following examples show how people sometimes expect women to be less interested or competent in technical areas than they actually are:

- According to a survey of female scientists:

> Women in mainly male environments are always being taken for secretaries or junior laboratory staff: queries may be addressed to a male technician rather than his female boss. An engineer offering to help a telephone caller was told 'No dear, this is a technical enquiry. Can I speak to someone who can help me?' [Ferry et al 1982, page 28]

- A female computer science professor told me this story:

  > I was visiting a university and arrived before my (male) host. I approached the departmental receptionist to try to make certain arrangements. In one case, I suggested that my host might have made some provision — 'or,' I said cordially, 'maybe not.' 'Oh, probably not,' replied the receptionist. 'After all you know those professors...' Boy was *her* face red when she realized what she'd said.[7]

- A female undergraduate at a women's college wrote:

  > The summer after my first year at [X] I took Linear Algebra at [a coed college] nearby. Out of probably twenty people in the class, I was one of two women. I found that the mood of the class was stifling. It was obvious that the men of the class expected me to sit quietly in my chair and contribute nothing and ask no questions. It was also made obvious to me that, in general, they felt they were far superior to me. Because I had had no contact with them outside of the classroom, I must assume they were basing their decision solely on the fact that I am female. In addition, I found the material relatively easy and was getting an A in the class, so they could not be basing it on my academic performance. One day as we were going over a difficult problem set we had had for homework, the professor asked if anyone was able to do a particular problem which I had been able to solve. When I raised my hand, [a student made] the comment 'What?!?! How could *you* have solved that problem!?!?' He in no way hid his hostility or his feelings that if he, a far superior man, could not solve the problem, I could

[7] It is fascinating to read about how female professionals and secretaries interact with each other. One professor reports that she used to sneak to the typewriter and type her own letters, rather than ask a secretary to do the work for her. Correspondingly, secretaries generally do not like to work for women. "They experience women's authority as 'unnatural', whereas men's authority is taken for granted" [Pringle 1989, page 58]. Additionally, as hinted by a comment in [MIT 1983, page 21], female secretaries feel demeaned when female professionals complain about being mistaken for secretaries. On the other hand, most of the secretaries I have worked with have treated me the same as they treated my male colleagues, and one has even told me outright how happy she was to see women as computer professionals.

> not have. I was completely shocked that he could make such a comment. No one else seemed to be. It is no wonder that women tend not to contribute in a male-dominated classroom.

- A female computer scientist sent me a copy of the cover of a prestigious computer periodical that showed a family (parents and a boy) looking at a computer. A bubble next to each shows what they are thinking. The mother is imagining her son using the computer to learn math and the father using it to figure taxes. The son and the father both imagine using the computer to play space war games.[8]

These diverse examples illustrate how women are sometimes treated as less capable or interested in technology than men, instead of being treated as individuals. Of course, there exist professors and administrators who treat their male and female students equally as well or even devote extra effort to encouraging women. However, negative events are still common enough to be of substantial concern. Moreover, the above behaviors are the symptom of a more fundamental problem: lower expectations for females. Many of the above events are too blatant to have the insidious effect of subtle discrimination (which probably accompany them). Even if the perpetrators could be coerced into not so openly displaying sexism, it would not eliminate the fundamental biases which would be displayed less directly.

1.2.3 Different Standards for Men and Women

As Sandler writes, the same behavior is viewed differently in women than in men:

> He is 'assertive'; she is 'aggressive' or 'hostile'. He 'lost his cool', implying it was an aberration; she's 'emotional' or 'menopausal'. Thus, her behavior is devalued, even when it is the same as his [Sandler 1988, page 151].

This claim can be illustrated by a recent lawsuit by a woman who "repeatedly heard that she had not been given a partnership at [a] huge accounting firm because she was too macho, universally disliked and in need of 'a course at charm school'" [Lewin 1990]. This is despite having brought in more business than any of the other 88 candidates for partnership. "Comments from the lawsuit [say] that she should wear makeup and jewelry and learn to walk, talk and dress 'more femininely'" [Lewin 1990]. A survey of female scientists found:

> Most think their male colleagues are more forceful and aggressive than they themselves want to be; some have resigned themselves to low status rather than changing their personalities, while others

[8] Cover, *IEEE Computer*, March 1977.

> have decided to fight with men's weapons — and are often labeled unfeminine as a result [Ferry et al 1982, page 30].

One study found the same behavior judged more harshly in female professors than in males:

> [According to] Susan Kay's classroom studies... male students were far more likely to give lower ratings to those female faculty perceived to be hard graders... This finding is consistent with a series of experiments at the University of Dayton that indicated that college students of both sexes judged female authority figures who engaged in punitive behavior more harshly than they judged punitive males... ([Martin 1984, pages 484–485] in [Koblitz 1990]).

See also [Kierstead et al 1988] and [Bennett 1982].

A "halo" effect seems to exist where people tend to interpret behavior according to their preconceptions. The same action is often interpreted differently, depending on whether it is performed by a woman or a man, as the following stories illustrate:

- When a high-ranking female engineer was at the airport to make a business trip, she saw a male acquaintance who worked for the same company. He asked where she was going, and she answered San Francisco. He then said something like, 'Oh, going to do some shopping?' She told me how angry his remark made her, as she works extremely hard at the company, putting in long hours and taking frequent business trips, with too little free time for her to go on out-of-state shopping trips even if she were inclined to do so.

- A female computer science graduate student told me that it is common to see different reactions to men and women dropping a class. According to her, when a woman drops a class, people remark that the class must have been too difficult for her; when a man quits, people say he must not have found it interesting.

These examples are troubling because they show one way in which stereotypes are perpetuated. In each case, someone interpreted the actions of a woman based on their prejudices, reinforcing their own stereotypes.

Additionally, women at American universities are often the victims of other cultures' stereotypes. Foreign nationals outnumber Americans as students in doctoral engineering programs [Widnall 1988, page 1740], and there are many foreign-born professors. In one survey, female graduate students at MIT "reported that foreign-educated faculty — many from cultures where women are not held in high esteem — pose problems for women in graduate programs, both in class and in research" ([MIT 1987] in [Baum 1990, page 49]).

1.2.4 Career-Related Success Unfeminine

Not only are some strong traits considered unfeminine, but "femininity and individual achievement continue to be viewed as two desirable but mutually exclusive ends," a shocking position argued in [Horner 1970, page 46], based on empirical research and interviews. In one of Horner's studies, females were given the sentence "After first-term finals, Anne finds herself at the top of her medical school class." Males were given a similar sentence with a male name. Subjects were asked to write a story about the student. While only 8 of the 88 male subjects exhibited fear of success through negative stories, 59 of the 90 females did. Horner divides the negative stories into three categories and includes sample stories, of which I include a subset:

1. Fear of Rejection — "Anne doesn't want to be number one in her class. She feels she shouldn't rank so high because of social reasons. She drops down to ninth in the class and then marries the boy who graduates number one."

2. Concern about Normalcy or Femininity — "Anne is completely ecstatic but at the same time feels guilty. She wishes that she could stop studying so hard, but parental and personal pressures drive her. She will finally have a nervous breakdown and marry a successful young doctor."

3. Denial — "Anne is really happy she's on top, though Tom is higher than she — though that's as it should be.... Anne doesn't mind Tom winning" [Horner 1970, pages 60–62].

Additionally, when questioned about Anne, "[m]ore than 70% ... described Anne as having an unattractive face, figure, or manners" [Horner 1970, page 63]. Females thus consider success to lessen their femininity, a sacrifice many are not willing to make [Horner 1970, pages 69–72]. See also [Mednick et al 1975].

This attitude can also be illustrated by the following incident, reported in [Franklin et al 1981, page 20]:

> One woman earned high grades in a traditionally male field. Her professor announced to a mostly male class that this represented an unusual achievement 'for a woman' and was an indication, first, that the woman student was probably not really feminine, and, second, that the males in the class were not truly masculine, since they allowed a woman to beat them.

Instead, the proper area for a woman's success is seen as her ability to attract high-status men. In a study for the National Institute of Education, researchers Holland and Eisenhart found:

> Men's prestige and correlated attractiveness come from the attention they receive from women *and* from success at sports, in school

> politics, and in other arenas. Women's prestige and correlated attractiveness come *only* from the attention they receive from men [Holland 1990, page 104, emphasis in original].

This attitude is exemplified by the way one college woman attempted to insult another: "[You] may be able to do calculus, but I'm dating a football player" [Holland 1990, page 104, brackets in original]. The study found that female friends often did not even know each other's majors [Holland 1990, page 14], although they spent large amounts of time together discussing other matters, primarily boyfriends [Holland 1990, page 14].

1.2.5 Implications of Gender Double Standards

The double standards discussed above should be a significant concern. Aggression, competitiveness, and even some brashness are necessary for a graduate student, for example, who must compete with other students for equipment, funding, and attention from professors. One doesn't get far by politely waiting to be noticed or for other people to stop using the computer. In her paper on being a female graduate student at MIT, Candace Sidner addresses some stumbling blocks women face:

> Receiving an advanced degree, in fact, any degree, from MIT is rather like being admitted to a fraternity. One has a certain set of rituals to go through, and both the process and one's performance define one's position in the fraternity in the years that follow....
>
> It surprises no woman to say that women are socialized differently than men in our cultures. What is surprising is the effect of that socialization when women take roles traditionally held only by men. The most significant role change centers [on] developing confidence and competence. Part of the process of hurdle jumping is not just the getting over, it is the form which one presents in doing it. For the MIT fraternity ritual, the form is confidence; a woman student must use what I call strutting behavior, that is, she must look and act like she knows what she is doing.
>
> While developing confidence from accompanying competence, is difficult for all initiates, for women there is a subtle, but remarkable difference; women in the everyday world are not supposed to appear very confident and competent.... As a result, women must not only build and show confidence and competence, just as their male counterparts do, but unlike the men, they must *decide* first to unlearn their normal behavior patterns....
>
> The strutting behavior appears slowly; there are stops and starts, forward and backward progress. A woman student begins to act from a little bit of confidence in her competence, and tests out this confidence among her peers and superiors. Two more difficulties

> follow. First, a woman feels less feminine, because in fact she is less feminine according to the prevailing behavior patterns. In her personal life, her feelings may be communicated to her partner(s) who may find her less attractive. This threatens her personal status. Eventually a woman can learn to find personal friends who value her confident image, but the time in between is frightening [Sidner 1980, pages 2–3].

Empirically, a comparative study of male and female Stanford graduate students in technical areas [Zappert et al 1984] found that women were less self-confident and assertive than their male peers:

> [W]omen less frequently than men reported that they felt free to disagree with their advisors...and that their ideas were respected by their advisors [Zappert et al 1984, page 9]....
>
> [W]omen more often reported having trouble saying "no" and in giving criticism. Women also more often reported having difficulty sticking up for themselves and tended to let annoyances pile up [Zappert et al 1984, page 12].

1.2.6 Specific Stereotypes Against Female Engineers

As if the culture-wide inhibitions to success were not enough, there are additional barriers in engineering. Nowadays, high school girls from middle- and upper-middle-class families are expected to go to college and to do reasonably well, but going to a technical institute or majoring in a technical field is still considered unfeminine, as these anecdotes indicate:

- When a female student at an engineering institute went home for vacation, her mother leafed through the book of photographs of the freshman class and exclaimed in surprise, "Why, some of these girls are pretty!"
- A male computer professional wrote:

  > Back in 1983, I was a freshman here at [X] and one of my friends was a genius who happened to be a pretty blonde girl....
  >
  > She was also a freshman and spent one of her first days here searching for her advisor's office. While hunting around [Y] Hall, a man in his early 30's came up to her and asked if she needed help. She said that she was looking for her advisor's office. The man responded with a puzzled, 'What major are you?' When she answered, 'I'm in Electrical Engineering.' The man smiled at her and oozed, 'Oh, you're *far* too pretty to be an EECS major.' [She] immediately left and told us in the dorms about this slimy guy.

> The next day we went to our first lecture for [the introductory computer class]. [She] gasped as one of the lecturers entered the hall. He was the same slimy guy she had encountered the day before....
>
> I'll never forget the quote, "Oh, you're *far* too pretty to be an EECS major."[9]

- A male computer professional wrote:

  > I used to teach undergraduate computer science classes, and saw a number of cases in which very promising and talented women abandoned computer science, much to my disappointment since they were some of my better students.... At least where I was teaching, the discouragement from that field was given more by other women, particularly in the sororities, rather than from within the field itself.

It is worth repeating, however, that the stereotype of male engineers is almost as bad. Jokes and television portray male engineers as unattractive, unpopular, awkward, and either unsuccessful with or uninterested in women.[10] However, I believe that in our culture, females are more susceptible to such stereotypes. This is in large part because, as described earlier in this chapter, femininity is considered to be at odds with success, while masculinity is not.

While the stereotype that female engineers are inherently unattractive seems to be without rational basis, scientific fields may well be in conflict with some values traditionally thought of as feminine and currently held by a majority of females. The situation seems not to have changed since the following was written:

> I think [women's lack of achievement] comes from the general orientation of girls, young women, and even older women, toward 'others' (in David Reisman's sense of being 'other directed'). Women are constantly urged to consider 'Am I doing the right thing?' and 'What shall I be or do that will please my husband, children, and parents?' Occupational success never comes out as the positive answer to these questions. Pleasing others and doing the 'right thing' always means holding back, and retreating from a position of strong ambition and career commitment [Epstein 1974, page 15].

I would add that being other-directed might steer women away from objective sciences into the humanities and the more people-oriented social sciences. Thus,

[9] In a later note, the writer added: "[The teacher] was fired two years after this incident. According to my advisor at that time, his attitude toward female students was one of the reasons. (He was not tenure track. He was a lecturer only.)" This story was later confirmed by a former professor from the university.

[10] See [Turkle 1984] for an interesting discussion of the male engineering student's self-image.

the values that are encouraged in women would not only make them less career-oriented but more likely to avoid the sciences.

1.3 Summary

In our society, males and females are regarded very differently. Assertiveness, confidence, and high achievement are considered consistent with masculinity but not with femininity. In addition to the stigma associated with success in general, technical fields are considered particularly unattractive for females. These factors can influence a girl not to pursue an interest in math or engineering, and they can sabotage a woman's career because either she acts feminine, e.g. demure, and is not taken seriously, or she acts masculine and is met with disapprobation. Of course, as mentioned in [Sidner 1980, page 3] and [Horner 1970, page 70], confident females eventually find male and female friends who like and respect them. The problem is thus not insurmountable. Still, it is an additional barrier that females face, and the playing field will not be level while these stereotypes exist.

Chapter 2

The Masculine Environment

> *I do not see that the sex of the candidate is an argument against her admission... After all, we are a university, not a bathing establishment* — David Hilbert, arguing unsuccessfully for the appointment of Emmy Noether to the faculty at Göttingen.[1]

Currently, the majority of professionals in computer science departments and workplaces are male. As a consequence, these places often have masculine environments in which women feel uncomfortable or unwelcome. The behaviors described in this chapter are generally not meant to be harmful to women, which makes the participants often hostile toward criticism. Such behaviors include the display of nude pictures, discussing sex, telling dirty jokes, and expressing negative stereotypes of women in an attempt at humor. Additionally, other activities are morally faultless, such as coworkers playing basketball together, but they may tend to make a woman feel less part of the group if she does not enjoy the same activities.

2.1 Sexist or Sexual Humor

Often, men make sexist or sexual remarks in attempts at humor. As the following examples show, this happens in classrooms, computer magazines, and at conferences. In most of these cases, the speaker probably means no harm. However, the behavior makes some women feel uncomfortable. In order to highlight the effect such statements have on women, their reactions have been included where available.

[1] Weyl, Hermann. "Emmy Noether", *Scripta Mathematica*, VIII, 3 (July, 1935), page 207.

- A female graduate student had the following experience:

> [A professor] in the introductory part of a guest lecture on robotics to the graduate core AI class: (approximate quote) 'Pretty soon we'll have robots that are sophisticated enough to wander around in shopping malls and pick up girls.' I didn't listen to the rest of the lecture, so I don't know what else he had to say.

- A female computer science professor wrote:

> When I was in graduate school, the professor in automata theory introduced the topic of decomposition by saying: 'Machines are a lot like women — many forms for the same function (wink wink).' As the only woman in the class, you can imagine that I felt terrific. And all of a sudden the guys sitting next to me sort of tensed up — instead of a fellow student, his remark had made them see me as something else, something kinda dirty.

- The narrator of the industry gossip column in the trade journal *Infoworld* is an adult male with a young girlfriend Pammy, shallow and uninterested in computers, whose silly statements and actions pad the columns, such as her return to beauty school. ("[A]t 21 she's older and can handle the pressure now.")[2]

- A female computer science professor wrote:

> [A]t a conference in France, a male speaker (French), who was speaking about the importance of testing, showed an overhead slide of a naked woman with a caption of the sort — 'Would you buy this product without testing it first?' There were only 2 or 3 women in the audience (of about 150), but I had fleeting feelings of having accidentally walked into a stag party and wondering if he had either not expected any women to be there or had discounted the importance of directing his remarks to the women in the audience.

What these examples all share is that the male speaker or writer was attempting to make a cute statement but that females (and some males) had negative reactions.

[2] Cringely, Robert X. "Notes from the Field". *Infoworld*, September 17, 1990, page 108.