

Women in STEM Text Set

Article A: “Bias Persists for Women in Science, a Study Finds” by Kenneth Chang *The New York Times* 9/24/12

Science professors at American universities widely regard female undergraduates as less competent than male students with the same accomplishments and skills, a new study by researchers at Yale concluded.

As a result, the report found, the professors were less likely to offer the women mentoring or a job. And even if they were willing to offer a job, the salary was lower.

The bias was pervasive, the scientists said, and probably reflected subconscious cultural influences rather than overt or deliberate discrimination.

Female professors were just as biased against women students as their male colleagues, and biology professors just as biased as physics professors — even though more than half of biology majors are women, whereas men far outnumber women in physics.

“I think we were all just a little bit surprised at how powerful the results were — that not only do the faculty in biology, chemistry and physics express these biases quite clearly, but the significance and strength of the results was really quite striking,” said Jo Handelsman, a professor of molecular, cellular and developmental biology at Yale.

Dr. Handelsman was the senior author of an article reporting the findings, published online on Monday by Proceedings of the National Academy of Sciences.

Nancy Hopkins, a professor of biology at the Massachusetts Institute of Technology who has long talked about continuing barriers to women in science, described the study as “enormously important.”

Dr. Hopkins said that small slights, accumulated over the course of a career, slowed many women of science. “They don’t have the confidence level to get to the top,” she said. “They’re getting undercut.”

She added, “People tend to think that the problem has gone away, but alas, it hasn’t.”

Discussions of gender bias in science and mathematics have long been complicated by a host of factors — including whether women receive preferential treatment through affirmative action or whether innate differences indeed exist between men and women.

To avoid such complications, the Yale researchers sought to design the simplest study possible. They contacted professors in the biology, chemistry and physics departments at six major research universities — three private and three public, unnamed in the study — and asked them to evaluate, as part of a study, an application from a recent graduate seeking a position as a laboratory manager.

All of the professors received the same one-page summary, which portrayed the applicant as promising but not stellar. But in half of the descriptions, the mythical applicant was named John and in half the applicant was named Jennifer.

About 30 percent of the professors, 127 in all, responded. (They were asked not to discuss the study with colleagues, limiting the chance that they would compare notes and realize its purpose.)

On a scale of 1 to 7, with 7 being highest, professors gave John an average score of 4 for competence and Jennifer 3.3. John was also seen more favorably as someone they might hire for their laboratories or would be willing to mentor.

The average starting salary offered to Jennifer was \$26,508. To John it was \$30,328.

The bias had no relation to the professors' age, sex, teaching field or tenure status. "There's not even a hint of a difference there," said Corinne Moss-Racusin, a postdoctoral social psychology researcher who was the lead author of the paper.

Dr. Handelsman said previous studies had shown similar subconscious bias in other occupations. But when she discussed the concerns with other scientists, many responded that scientists would rise above it because they were trained to analyze objective data rationally.

"I began to, on the one hand, wonder, 'Well, perhaps that's true: maybe people who are trained to be objective have some way of ferreting these out,' " she said. "But on the other hand, if scientists were no different from all the other groups that have been studied, that's something that we should know."

Chang, Kenneth. "Bias Persists for Women in Science." *The New York Times*. 9/24/12. 12/18/12 <<http://www.nytimes.com/2012/09/25/science/bias-persists-against-women-of-science-a-study-says.html>>.

Article B: "Reporter Examines Gender Gap in Math and Science" *NPR* 5/31/08

Ever since experts became aware of a gender gap in science and technology, they've been trying to figure out who's to blame. Often the blame has been placed on old fashioned sexism. What amounts to a boys club in many sciences and technologies that excludes women. But a recent article in the Boston Globe suggests that the answer may be women in western societies have so many opportunities, they freely choose another field.

The writer of that article called "The Freedom to Say No" is Elaine McArdle. She joins us from member station WBUR in Boston. Ms. McArdle, thanks so much for being with us.

Ms. ELAINE MCARDLE (Writer): Thank you for having me.

SIMON: You described two separate research projects that seemed to come out at the same conclusion that men and women make different choices. Let's talk about the Vanderbilt project first where scientists, I gather, took a look at what happened to 5,000 mathematically gifted boys and girls over 30 years.

Ms. MCARDLE: That's right. The two researchers there started more than 30 years ago looking at students were very gifted in math and had scored very high on the math SAT and then followed them over the next decade to see the career choices and educational choices that they made.

SIMON: And?

Ms. MCARDLE: Well what they found was that the men tended to go into engineering, math, and computer science and then women tended to go into medicine and biological sciences or not to be in science at all.

SIMON: And what were some of the motivating factors?

Ms. MCARDLE: One of the interesting findings was that women who are very, very good at math also tend to be very good verbally so that their career options are broader than men. Men who are very good at math tend to not be as good as women in verbal skills. So that a woman who's tremendous at math could be a doctor, could be an engineer but she could also be a lawyer or she could do something entirely different altogether.

SIMON: You also site the research of someone named Joshua Rosenbloom who's an economist at the University of Kansas. What was his project?

Ms. MCARDLE: Joshua Rosenbloom developed a study that looked at computer careers, IT careers to look at why there were fewer women in that field than men. And what he found, what he and his colleagues found was that the single biggest factor was preference, what women prefer to do at work.

SIMON: Now would it be fair to say that women just enjoy working with people in greater percentage.

Ms. MCARDLE: That is what both of these studies found. The IT study, for example, found that most of the time women prefer to work with other people or other kinds of organic situations where men most of the time prefer to work in inorganic situations, manipulating tools and that kind of thing.

SIMON: You described another study by the Canadian psychologist Susan Pinker that compares countries with more or less freedom of choice for women and what they wind up doing in their careers. What did she find?

Ms. MCARDLE: That was particularly interesting in that you might assume that in a country where women were given complete freedom of choice or near to it in careers that they would end up making the same decisions that men did in their careers. What she found was that it was actually not that at all. That in countries where women had a lot of educational opportunity and a lot of freedom of choice, there was a bigger gender gap and the careers that they went into.

SIMON: Now there are some people who look at the same numbers and draw different conclusions. Why don't you bring us their arguments too?

Ms. MCARDLE: Naturally anyone who looks at this kind of study and these kind of results gets concerned because you worry that it will be used or leaned upon to allow sexism to continue in various fields. What these researchers as I talked with them emphasize - they are not saying that sexism does not exist, they're saying however, that in the rich stew of someone's career choice, preference is something that should be paid attention to that has not really been considered at all.

SIMON: Ms. McArdle, thanks so much.

Ms. MCARDLE: Thank you very much. It was really enjoyable.

SIMON: Elaine McArdle is a writer in Cambridge, Massachusetts. Her article "The Freedom to Say No" was published in the May 18 edition of the Boston Globe magazine and she is co-author of a forthcoming book in September, "The Migraine Brain."

Source Citation

"Reporter Examines Gender Gap in Math and Science." *Weekend Edition Saturday* 31 May 2008. *Opposing Viewpoints in Context*. Web. 17 Dec. 2015.

Article C: "Why do so many women who study engineering leave the field?" By Susan S. Silbey *Harvard Business Review* 8/23/16

Engineering is the most male-dominated field in STEM. It may perhaps be the most male-dominated profession in the U.S., with women making up only 13% of the engineering workforce.

For decades, to attract more women to the field, engineering educators have focused on curriculum reform (e.g., by promoting girls' interest in math and science). While these efforts have brought in more women to study engineering, the problem is that many quit during and after school. Focusing solely on education doesn't address the fact that women tend to *leave* the profession at a higher rate than men. Women make up 20% of engineering graduates, but it's been estimated that nearly 40% of women who earn engineering degrees either quit or never enter the profession.

So why do women who study engineering leave to pursue careers in other fields? We explored how the culture within engineering—the shared values, beliefs, and norms—might contribute to the under-representation of women in the profession. We found that female students do as well or better than male students in school—but often point to the hegemonic masculine culture of engineering itself as a reason for leaving.

Beginning in 2003 we have been following 700 engineering students across four schools—MIT, UMass, Olin College of Engineering, and the women-only Picker Engineering Program at Smith College. Although our sample is not representative of all engineering students, the variety of schools (elite private college, public land-grant institution, engineering-only college, and single-sex college) let us examine different approaches to engineering education.

We surveyed these students yearly during their four years of college and then again five years after they graduated, asking them about their interactions with other students and teachers in classes and on projects, how they felt about the college culture, and what their occupational and family expectations were for the future. We also collected personal diary entries from 40 of these students (19 men, 21 women), who wrote to us at least twice a month about the educational and career decisions they were making. In addition, we interviewed 100 students (38 men, 62 women) during both their freshman and senior years.

Why men and women enter engineering

We found that men and women had similar reasons for enrolling in engineering. They describe being good at math and science in high school and wanting interesting, well-paid professional opportunities in the future. However, women, more often than men, add that they want to become socially responsible engineers, working to solve major problems and making a difference in people's lives—which is consistent with other research showing that women are significantly more likely than their male counterparts to be interested in engineering work that is “socially conscious” (i.e., specializations such as environmental vs. electrical engineering). For example, in our study, Juliette and Graciela (all names have been changed) wrote that they wanted to use their engineering skills to improve the situations of their countries of origin in Africa and Latin America. Megan, echoing others, hoped to use her engineering skills in “some type of humanitarian work.” This initial aspirational difference grew during their engineering education.

Throughout college, men and women succeeded equally in the classroom. However, we observed that women started to doubt their problem-solving abilities more than men. As Ashley described to us:

The biggest problem I seem to be having [is] self-doubt. I would look at a problem, and think of a way to solve it, but then I would second guess myself, and convince myself that my way of answering the question must be wrong, but then, it would turn out that I was correct the whole time. I don't understand why I keep doubting myself so much... Lack of confidence has never ever been a problem for me.

Women were also much more likely to look to others—teaching assistants, professors, and advisors—to affirm, and reaffirm, their confidence. Men did talk about doubting themselves, but they did not necessarily seek reassurance from others. We found that this search for positive cues carried over into expectations for feedback from supervisors in internships and jobs.

Why women start to change their minds

Each profession introduces students to its distinct culture, skills, language, practices, and values. Engineering students observe and practice these through group projects, where they learn how to think and act like engineers. They quickly discover that collaboration and teamwork constitute a core component of being an engineer.

For many women engineering students, however, their first encounter with collaboration is to be treated in gender stereotypical ways, mostly by their peers. While some initially described working in teams positively, many more reported negative experiences. When working with male classmates, for example, they often spoke of being relegated to doing routine managerial and secretarial jobs, and of being excluded from the “real” engineering work. Kimberly wrote, “Two girls in a group had been working on the robot we were building in that class for hours,

and the guys in their group came back in and within minutes had sentenced them to doing menial tasks while the guys went and had all the fun in the machine shop.”

There were also descriptions of being treated differently by professors. Rachel described when her team (the only all-girl team) won second place in a design competition: “Our professor wanted to get a picture of our prototype and us. We picked up our prototype and were all smiling and looking all professional; then he said: ‘You guys look like professional catalog models; this picture could go in a catalog and you could sell big time.’”

Men, on the other hand, described mandatory group design projects as exciting turning points, where theory and practice come together. “I made a pretty big stroke of progress last week,” one student wrote in his semi-monthly diary, “I ended up proving the professor wrong on something she had done last year, which actually helped us find better results (well, also more correct results)... It’s really a blast working on something like that.”

Exposure to the workplace causes concern

Internships and summer jobs provide students additional opportunities to “try on” the role of engineer—and the culture. We found that these work sites echoed the gender stereotyping experienced in school projects: men were assigned interesting problem-solving tasks where they could develop their analytic and technical skills, while women were often assigned jobs sorting papers, copying, collecting equipment, writing notes, and coordinating—tasks they felt did not value or cultivate their skills.

Almost without exception, men reported the experience of internships and summer jobs as a positive, often even a highlight of their education. Women’s reports were not as uniformly positive. Of course, some women spoke highly of their internships, while others felt they were not given equal opportunities.

For example, Aurora described an early internship experience at a military defense contractor: “The environment was creepy, with older weirdo man engineers hitting on me all the time and a sexist infrastructure was in place that kept female interns shuffling papers while their oftentimes less experienced male counterparts had legitimate engineering assignments.”

Rachel offered similar observations: “One thing that really bugs me about being an intern and a young girl is that the people whom I work with don’t take me seriously. Not everyone does this, but a fair amount of the older men in my working environment do this. They’ll treat me like I know nothing.”

This second round of gender stereotyping in the workplace, coupled with unchallenging projects, blatant sexual harassment, and greater isolation from supportive networks, leads many female students to revisit their ambitions. Women begin to question whether engineering is what they really want to do. For example, Haley, Taylor, and Heather explicitly articulated worries that the

career path looked too “boring” and “unfulfilling.” Jennifer described how she was “seriously offended” when a supervisor spoke to her about appropriate dress, reminding her “No tank tops, now. We wouldn’t want to distract the guys.” Another student wrote,

“But, one thing that really bugs me about being an intern and a young girl is that the people whom I work with don’t take me seriously. Not everyone does this, but a fair amount of the older men in my working environment do this. They’ll treat me like I know nothing... What they don’t know is that I have a 3.7 GPA... I never used to really care, but now when it interferes with my profession, it just irritates me.”

Further, many women discover in their internships that the engineering profession is not as open to being socially responsible or as dedicated to tackling pressing national and global problems as they had hoped. This is a result of the assignments they are given, the values that are supported, and the messages that are communicated to them.

Our recent work helps explain why some women who go to college intending to be engineers end up leaving the profession before even starting their careers. Of course, not all of the men we studied decided to pursue engineering careers, but they wrote that they appreciated the tools that their education gave them. Women’s experience of their education differed along two critical dimensions — they encountered a culture where sexism and stereotypes were left unaddressed, and they saw only lip service offered toward improving society—and both of these disproportionately alienated them.

The number of women and men are nearly equal in law and medicine, and the number of women in basic sciences is growing annually. With such a low proportion of female engineers nationally, educators and businesses need to pay more attention to how an occupation founded on a commitment to complex problem-solving so consistently fails to repair its well-documented gender problem.

Efforts focused only on changing the curriculum are insufficient because they simply reproduce the norms and practices of the profession. In order to curb the high rates of women leaving the field, engineering programs need to address gendered tasking and expectations among teams, in class and at internship work sites. The culture has to learn to take women seriously.

<https://hbr.org/2016/08/why-do-so-many-women-who-study-engineering-leave-the-field>

Article D: “Why the STEM gender gap is overblown” by Denise Cummins *PBS Newshour* 4/17/15

There are two universally accepted “truths” about women and STEM careers (science, technology, engineering, and mathematics). The first is that men outnumber women in in these fields, and the second is that women are socialized to avoid STEM as career choices, because society considers them “unfeminine.”

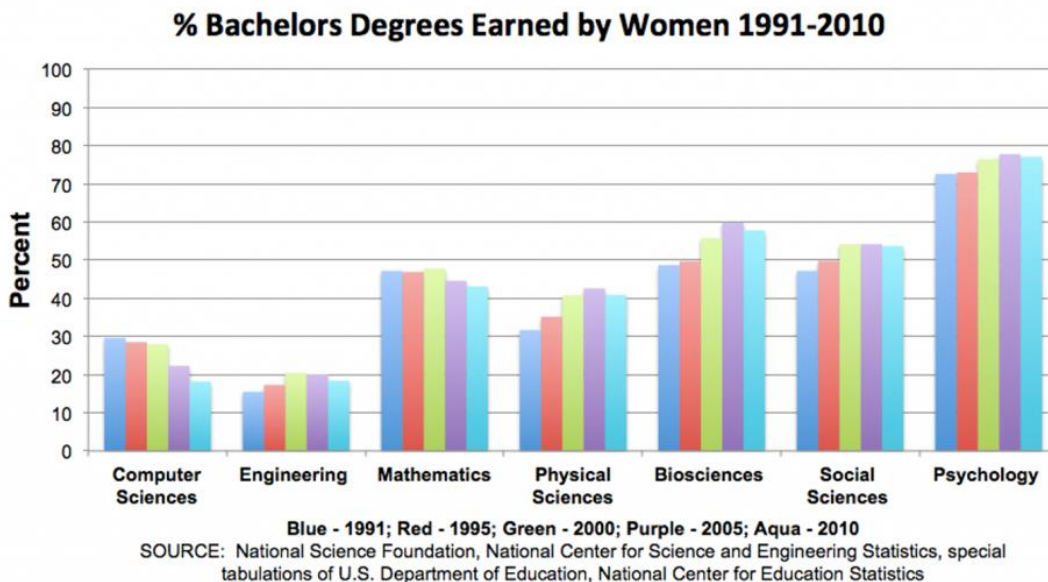
These beliefs have spawned a national effort on the part of the National Science Foundation to attract girls and young women into STEM. The preferred strategy is to attract females by “unbrainwashing them” into accepting STEM careers as appropriate for women.

On closer inspection, it turns out that these “truths” are nothing more than assumptions, and that these assumptions are inconsistent with the facts. Here are the facts:

1. Men do not outnumber women in all STEM fields

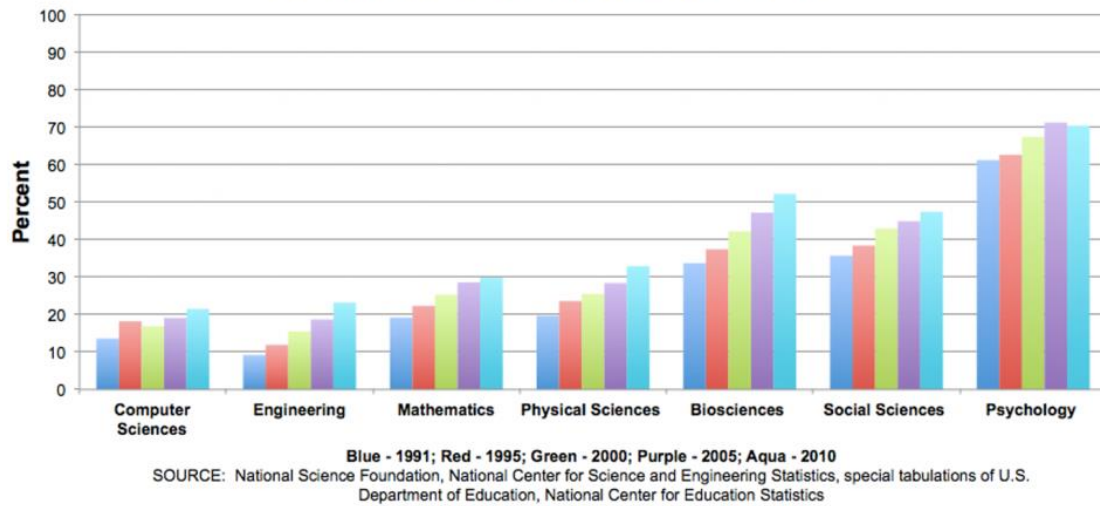
Gender equity in STEM means that females account for 50 percent of the individuals involved in STEM fields. When we look at the percentage of STEM bachelor’s degrees awarded to female students for the last two decades, based on NSF statistics, we find that there is no gender difference in the biosciences, the social sciences, or mathematics, and not much of a difference in the physical sciences. The only STEM fields in which men genuinely outnumber women are computer science and engineering.

I created the following graphs, based on NSF data, to show women’s completion of bachelor’s degrees and PhDs in specific fields between 1991 and 2010.



At the Ph.D. level, women have clearly achieved equity in the biosciences and social sciences, are nearly there (40 percent) in mathematics and the physical sciences, and are “over-represented” in psychology (78 percent). Again, the only fields in which men greatly outnumber women are computer science and engineering.

% PhD Degrees Earned by Women 1991-2010



When we look at the actual workforce, we see the same pattern. Women are as likely as men to be biological scientists, medical scientists and chemists. They are much less likely than men to be computer scientists, but have achieved equity in three out of five areas, with computer science and geoscience being exceptions.

United States Labor Force

Occupation	Percent of Women ¹
Biological Scientists	50.1%
Medical Scientists	52.8%
Chemists and Materials Scientists	44.2%
Computer and Mathematical Occupations	25.6%
Environmental Scientists and Geoscientists	25.7%

2. Women and men are equally capable of doing STEM work

One explanation for sex difference in STEM fields is that women just don't have what it takes to succeed in the "hard" sciences, computer science, or engineering. Some have even argued that women are not smart enough for these fields.

The fact is that men and women score equivalently on tests of raw IQ, with some studies showing women scoring slightly higher. When it comes to mathematics—a core requirement for science and engineering—women score on average only 32 points lower than men on the SAT—a mere 3 percent difference. While men outnumber women in the “genius” SAT math score range (700-800), the ratio is not that large (1.6 to 1). Men show only an insignificant five-point advantage over women on the quantitative section of the Graduate Record Examination, and they score one point lower than women on the analytic section.

It is also not the case that more undergraduate men than women are selected by top engineering programs. Of the top STEM programs in the country, most have male-to-female undergraduate student ratios close to 1:1.

3. Sex-linked interest preferences are not mere artifacts of socialization

One interpretation of the sex difference in STEM careers (and the workforce in general) is that females are pressured into areas that are more “gender appropriate,” not that they are choosing to study what is intrinsically more interesting to them.

For example, former American Association of University Women senior researcher Andresse St. Rose, one of the authors of “Why So Few? Women in Science, Technology, Engineering, and Mathematics,” puts it this way:

Another common but somewhat misguided explanation for female underrepresentation in STEM is that while girls and young women may be just as able as young men, they are not as interested in science and engineering. From early adolescence, girls report less interest in math and science careers than boys do (Turner et al. 2008), and among children identified as mathematically precocious, girls were less likely than boys to pursue STEM careers as adults (Lubinski and Benbow 2006). Girls’ lower reported interest in STEM may be partially explained by social attitudes and beliefs about whether it is appropriate for girls to pursue these subjects and careers.

The problem with this “blank slate” interpretation of gender differences is that it doesn’t jibe with results of developmental studies. Newborn girls prefer to look at faces while newborn boys prefer to look at mechanical stimuli (such as mobiles). When it comes to toys, a consistent finding is that boys (and juvenile male monkeys) strongly prefer to play with mechanical toys over plush toys or dolls, while girls (and female juvenile monkeys) show equivalent interest in the two. (See this for summary of this research.) These sex-linked preferences emerge in human development long before any significant socialization can have taken place. And they exist in juvenile non-human primates that are not exposed to human gender-specific socialization efforts.

It is not difficult to see how such early emerging preferences can end up shaping career choices later on: Women tend to gravitate toward fields that focus on living things and agents, men to fields that focus on objects.

4. Different preferences don't mean women's are less important

The hidden assumption underlying the push to eliminate gender gaps in traditionally male-dominated fields is that such fields are intrinsically more important and more valuable to society than fields that traditionally appeal to women.

The hidden assumption underlying the push to eliminate gender gaps in traditionally male-dominated fields is that such fields are intrinsically more important and more valuable to society than fields that traditionally appeal to women. So we must turn women into men so that women can achieve economic parity with men. As Facebook Chief Operating Officer Sheryl Sandberg put it in her book “Lean In,” we need to set a goal of getting more women “in the door” of male-dominated, prestigious, and high-paying fields, even if doing so requires that women act more like men.

But what happens when women follow this advice and follow the “lure” of prestige and wealth offered by male-dominated professions? Kate Bahn, an economics Ph.D. candidate at the New School, put it this way in her blog *The Lady Economist*:

...I sometimes wonder to what extent my desire to be taken seriously, like one of the boys, played into my decision to become an economist over, say, a sociologist.

and

Do other fields perceived as masculine also attract a certain type of woman, like me, who is drawn to the power and seriousness connoted with masculinity? And what does it say about me, as a staunch feminist, if I'm relying on masculinity to convey my worth

Yes, indeed, what does it say when women must adopt male values wholesale in order to command real social, political, and economic power? Or perhaps the better question is: Why are the fields that appeal to men so much better compensated than the fields that appeal to women? My answer to this question is...

5. Men earn more because they believe they are worth more—and women agree

Nursing, a traditionally female-dominated profession surely has more intrinsic value to society than trading stocks, yet nurses make a fraction of what high-frequency traders make. And nursing did not bring about a global economic crisis that the taxpayer was required to bail out. Yet when the percentage of male nurses increased from a miniscule 3 percent in 1970 to 10 percent in 2011, something else very interesting developed: a gender pay gap in the field of nursing. In 2011, the average female nurse earned \$51,100, 16 percent less than the \$60,700 earned by the average man in the same job.

It is difficult to avoid the conclusion that male-dominated professions are high-status and well-paid precisely because they are male-dominated, and female-dominated professions are low-status and poorly-paid precisely because they are female-dominated. When men move into traditionally female-dominated professions, the salaries and status levels of those professions rise because men demand—and get—more for the work they do.

When men move into traditionally female-dominated professions, the salaries and status levels of those professions rise because men demand—and get—more for the work they do.

This is more than just conjecture. The fact that women undervalue themselves (and by extension, the work they do) has been amply demonstrated in carefully designed experimental economics studies. The two most frequently studied economics games are the dictator and ultimatum games. In the dictator game, one individual is given full authority to keep or share a sum of money with another player. On average, women keep less for themselves than men do. In the ultimatum game, one person is allowed to make an offer as to how the money should be divided, and the other party is given the opportunity to accept or reject the offer. If the offer is rejected, no one gets any money. Both men and women make lower offers to women than to men. Other studies have found that women negotiated harder when they were working on behalf of others rather than for themselves, which implies a reluctance to push their own interests.

Rather than rushing to traditionally male professions to shore up our status and our income levels, perhaps we need to reject the implicit belief that men and whatever men are doing must be important and valuable, and whatever women are doing must be the career dregs that men fobbed off on us simply because they found that work intrinsically less interesting.

The bottom line

Women are clearly capable of doing well in STEM fields traditionally dominated by men, and they should not be hindered, bullied, or shamed for pursuing careers in such fields. But we also should not be ashamed if our interests differ from men's. If we find certain careers more intrinsically rewarding than men do, that does not mean we have been brainwashed by society or herded into menial fields of labor. Instead, we should demand that greater intrinsic and monetary compensation be awarded to the work we like and want to do.

<http://www.pbs.org/newshour/making-sense/truth-women-stem-careers/>