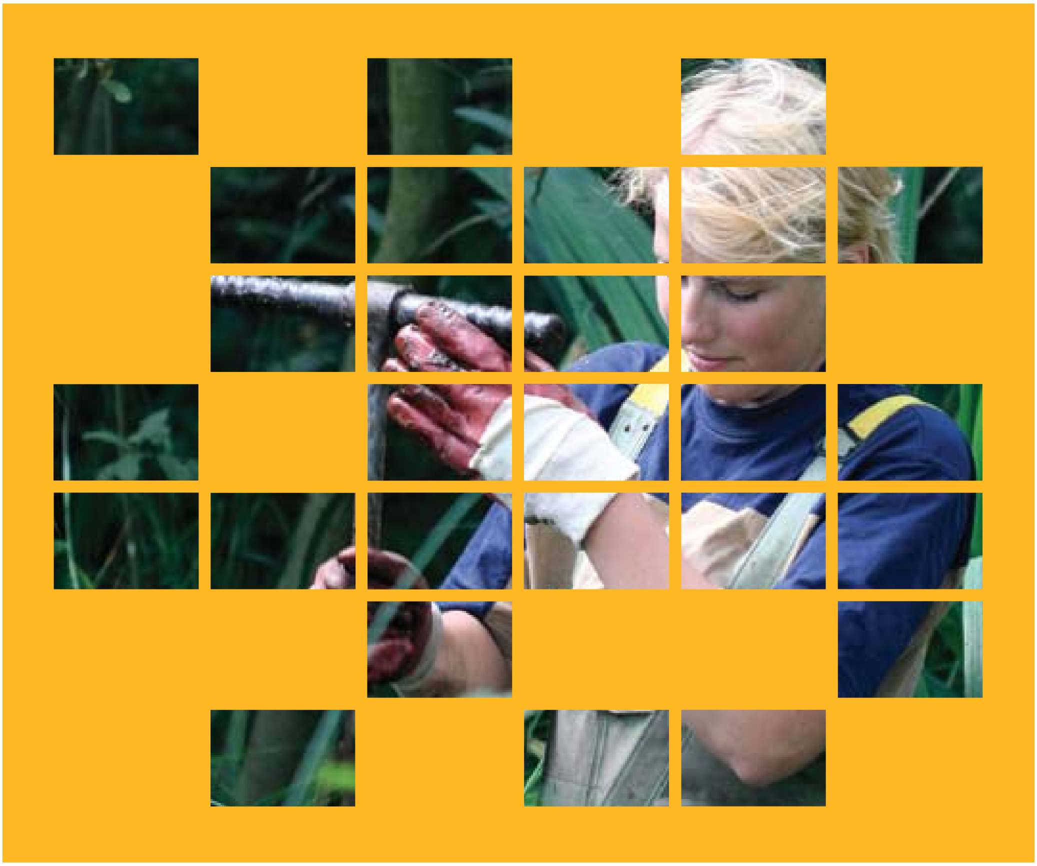


Chapter 4.
Self-Assessment

> Boys do not pursue mathematical activities at a higher rate than girls do because they are better at mathematics. They do so, at least partially, because they ***think*** they are better.
>
> —Shelley Correll[5] [emphasis added]

Fewer girls than boys say they are interested in science or engineering careers (American Society for Quality, 2009; WGBH, 2009). The work of Shelley Correll, a sociologist at Stanford University, sheds light on how girls' and women's seemingly voluntary decisions to avoid STEM careers are influenced by the cultural belief that science and math are male domains. Correll's research focuses on self-assessment and its consequences for interest in math and science. She found that among students with equivalent past achievement in math, boys assessed their mathematical ability higher than girls did. Controlling for actual ability, the higher students assessed their mathematical ability, the greater the odds were that they would enroll in a high school calculus course and choose a college major in science, math, or engineering. Correll found that boys were more likely than their equally accomplished female peers to enroll in calculus not because boys were better at math but because they believed that they were better at math. When mathematical self-assessment levels were controlled, the previous higher enrollment of boys in calculus disappeared and the gender gap in college major choice was reduced (Correll, 2001). In a follow-up study Correll (2004) verified in a laboratory experiment that when cultural beliefs about male superiority exist in any area, even a fictitious one, girls assess their abilities in that area lower, judge themselves by a higher standard, and express less of a desire to pursue a career in that area than boys do.

Undoubtedly, many factors influence an individual's career choice, but at a minimum, individuals must believe they have the ability to succeed in a given career to develop preferences for that career. If girls do not believe they have the ability to become a scientist or engineer, they will choose to be something else. Correll's research findings suggest that helping girls understand that girls and boys are equally capable in STEM areas will increase girls' self-assessment of their math and science skills, which, in turn, will increase girls' aspirations for careers in STEM fields.

Correll first became interested in the differences between boys' and girls' assessments of their science and math abilities when she taught high school chemistry for a few years before attending graduate school. She noticed that no matter how poorly the boys in her chemistry

---

[5]Shelley Correll is an associate professor of sociology at Stanford University. Her research examines how cultural beliefs about gender influence educational and career paths. In addition to her work on self-assessment described in this chapter, her most recent project considers how stereotypical beliefs associated with motherhood influence the workplace evaluations, pay, and hiring of women who give evidence of being a mother.

classes did, they continued to think that they were very good at chemistry; however, no matter how well the girls performed, it was difficult for Correll to convince them that they actually had some scientific ability. Once in graduate school Correll focused on how gender stereotypes attached to different skills or tasks influence how girls and boys understand their abilities independent of test scores or grades and how these gender differences in self-assessments contribute to gender differences in career choice.

STEREOTYPES AND SELF-ASSESSMENTS

How do stereotypes affect self-assessments? Correll explains that we use stereotypes as "cognitive crutches" in situations in which we do not know how to judge our performance. Research shows that even individuals who do not personally endorse beliefs that men are better than women at math are likely to be aware that these beliefs exist in the culture and expect that others will treat them according to these beliefs. This expectation, or what we think "most people" believe, has been shown to influence judgments (Foschi, 1996; Steele, 1997; Lovaglia et al., 1998). If a girl believes that most people, especially those in her immediate environment, think boys are better than girls at math, that thought is going to affect her, even if she doesn't believe it herself. Even if no one really believes that boys are better at math, the fact that a girl thinks they believe it is what matters. This is the reason that the 2005 comments of Larry Summers—the former Harvard president who famously doubted that women are capable of succeeding at the highest levels of science and engineering—were so damaging. Because he spoke from such a powerful position, his remarks gave credibility to the stereotype that women may lack the aptitude to succeed in STEM fields.

Correll published a study in 2001 that looked at the correlation between students' math achievement and self-assessment of their math ability by gender and the influence that self-assessment has on persistence on a path to a STEM career. This study analyzed the National Educational Longitudinal Study of 1988 (NELS-88), a national dataset of more than 16,000 high school students. The first NELS-88 survey was conducted in 1988 when the students were in the eighth grade. A subsample of the original students was again surveyed in 1990, 1992, and 1994, when most were sophomores, seniors, and two years beyond high school, respectively.

Correll identified three items on the survey as indicators of mathematical self-assessment: "Mathematics is one of my best subjects," "I have always done well in math," and "I get good marks in math." Students were asked to agree or disagree, on a six-point scale, with these statements during their sophomore year of high school. Student mathematical achievement was approximated through past math test scores and average math grades that students received in high school. Correll's analysis showed that high school boys were more likely than their female counterparts of equal past mathematical performance to believe that they were competent at mathematics. Interestingly, the effect was reversed when the students assessed their verbal ability: female students made significantly higher self-assessments of verbal ability, controlling for actual verbal performance. This suggests that stereotypes about gender influence students' perceptions of their abilities in particular fields: boys do not assess their task competence higher than girls do in every area, just in the areas considered to be masculine domains.

Most important for understanding how gender differences in self-assessment influence women's underrepresentation in science and engineering, Correll's research found that higher mathematical self-assessment among students of equal abilities increased students' odds of enrolling in high school calculus and choosing a quantitative college major. In her sample, she found that boys were 1.2 times more likely than their equally capable female counterparts to enroll in calculus. Correll found this difference to be due to differences in self-assessment. When girls and boys assessed themselves as equally mathematically competent, the gender difference disappeared, and girls and boys were equally likely to enroll in calculus. Likewise, 4 percent of female students compared with 12 percent of male students in Correll's sample chose a college major in engineering, mathematics, or the physical sciences. Although controlling for mathematical self-assessment did not eliminate this gender difference in college major choice, it did reduce the difference. Together these findings suggest that cultural beliefs about the appropriateness of one career choice over another can influence self-assessment and partially account for the disproportionately high numbers of men in the quantitative professions, over and above measures of actual ability (Correll, 2001).

Interestingly, Correll found that young women who enrolled in high school calculus were about three times more likely than young women who did not take calculus to choose a quantitative major in college. In comparison, young men who enrolled in calculus were only about twice as likely as young men who did not take calculus to choose a quantitative major. Thus it appears that taking calculus in high school is a better predictor of selecting a quantitative college major for women than it is for men. Another interesting finding was that higher verbal self-assessments decreased the odds of enrolling in calculus and choosing a quantitative major, indicating that students use relative understandings of their competencies when making career-relevant decisions. Lubinski and Benbow (2006) showed that girls who do very well at math are more likely than their male peers to do very well at verbal tasks as well. In addition to societal expectations, relatively strong verbal abilities may encourage mathematically talented girls to consider future education and careers in the humanities or social sciences rather than science and engineering fields.

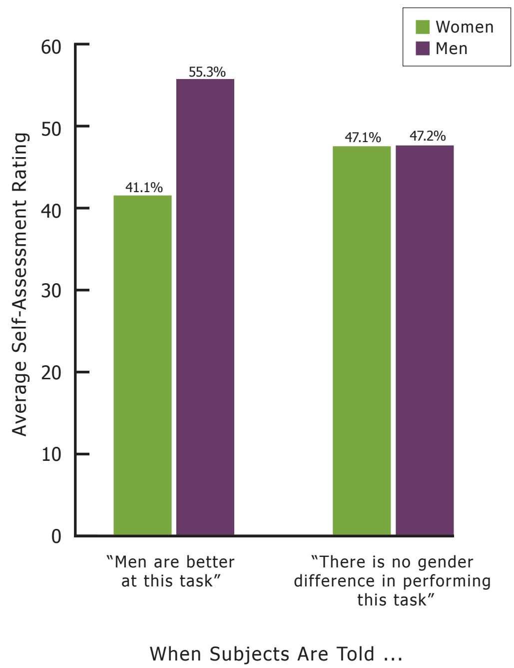
In a follow-up study Correll (2004) tested her theory that boys assess their abilities higher and express higher aspirations to pursue a career in areas considered to be male domains in an experimental setting. She conducted this experiment to show that cultural beliefs about gender, not actual gender differences, influence self-assessments about math. The previous study relied on the assumption that the students in the sample were aware of the cultural beliefs about gender and mathematical abilities, and this awareness caused the observed gender differences in self-assessments of competence. Since Correll could not isolate and manipulate students' exposure to gender beliefs associated with these abilities in that study, however, she could not be sure that cultural beliefs about gender caused the difference in self-assessment and not, for example, some additional component of "real" mathematical ability not captured by math grades and test scores. To account for this possibility, Correll designed an experiment around a fictitious skill called "contrast sensitivity ability." In this experiment, participants were given evidence that contrast sensitivity ability (the ability to detect proportions of how much black and white appeared on a screen) was either an ability that men were more likely to have (male advantage or "MA" condition) or an ability that showed no gender difference (gender dissociated or "GD" condition). Participants included 80 first-year undergraduate students divided into four groups: 20 men and 20 women in the MA group and 20 men and 20 women in the GD group.

Participants completed two 20-item rounds of a computer-administered contrast-sensitivity test in which subjects had five seconds to judge which color (black or white) predominated in each of a series of rectangles. Unbeknownst to the subjects, the amount of white and black was either exactly equal or very close to equal in each rectangle, so the test had no right or wrong answers. Nonetheless, all subjects were told that they had correctly answered 13 of the 20 items during round one and 12 of 20 in round two. Participants were then asked to assess their performance and indicate their interest in pursuing a career requiring contrast-sensitivity ability.

In the MA group, men assessed their contrast-sensitivity ability and their interest in pursuing careers requiring this ability higher than women did, even though all participants received identical scores on the tests. Because the test had no right answers, men could not really be better at the contrast-sensitivity task; yet when told that men excelled at this ability, they assessed their own abilities higher than women assessed their own abilities and expressed more interest than women did in using this ability in a future career. When Correll controlled for level of self-assessment, a gender difference no longer existed in aspirations for a career requiring high contrast-sensitivity ability, which suggests that higher self-assessment among the men led them to express more interest than women did in using this ability in a future career. In the GD group, where the fictitious skill was described as equally likely to be held by women and men, no gender differences appeared in assessments of ability or interest in using the skill in the future (Correll, 2004) (see figure 16).

Perhaps the most interesting finding from this study is that women and men held different standards for what constituted high ability in the MA condition. In the MA condition, women believed they had to earn a score of at least 89 percent to be successful, but men felt that a minimum score of 79 percent was sufficient to be successful—a difference of 10 percentage points. In the GD condition, women and men had much more similar ideas about how high their scores would have to be to assess themselves as having high task ability: women said they would need to score 82 percent, while men said they would need to score 83 percent (see figure 17). This finding suggests that women hold themselves to a higher standard than their male peers do in "masculine" fields.

Figure 16. Self-Assessment of Ability, by Gender

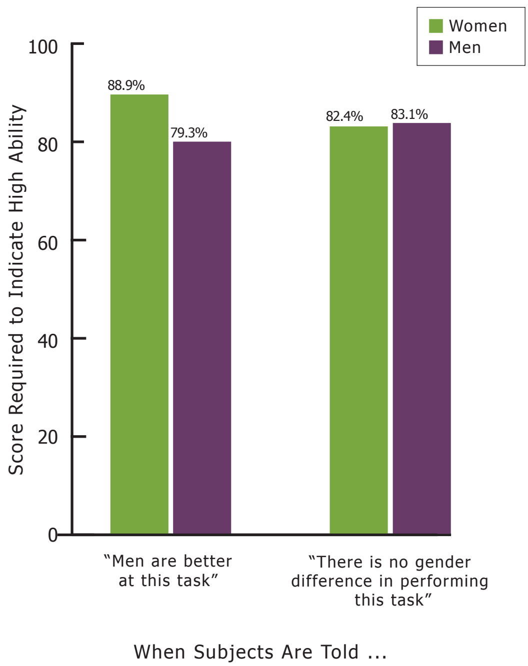


Source: Correll, S. J., 2004, "Constraints into preferences: Gender, status, and emerging career aspirations," *American Sociological Review, 69*, p. 106, Table 2.

Correll's findings suggest that the mere fact that science, technology, engineering, and mathematics are commonly considered to be masculine domains may increase men's self-assessment of their abilities and interest and lower women's self-assessment and interest in pursuing careers in these areas. Additionally, the research indicates that women believe that they must achieve at exceptionally high levels in math and science to be successful STEM professionals. If women hold themselves to a higher standard than men do, fewer women than men of equal ability will assess themselves as being good at math and science and aspire to science and engineering careers.

Fortunately, the findings also suggest that it is possible to alter the standards individuals use by altering the beliefs in their local environments. In the study, none of the participants had ever heard about contrast-sensitivity ability, so no one had preconceived ideas about it.

Figure 17. Students' Standards for Their Own Performance, by Gender



Note: Respondents were asked, "How high would you have to score to be convinced that you have high ability at this task?"
Source: Correll, S. J., 2004, "Constraints into preferences: Gender, status, and emerging career aspirations," *American Sociological Review, 69,* p. 106, Table 2.

Yet when participants were told that men are better at the task, women used a higher standard to assess their abilities than the standard men used to assess themselves. When participants were told that no gender difference existed in task performance, the gender difference went away, and women and men assessed themselves by nearly the same standard. This suggests that people—teachers and parents in particular—have an opportunity to affect the standards that girls and boys and women and men use and, therefore, the assessments that they make by emphasizing the lack of gender difference in performance in nearly every STEM subject.

As mentioned previously, fewer girls than boys say they are interested in becoming scientists or engineers. But how do girls form interests and career aspirations? Individuals form career aspirations in part by drawing on perceptions of their own competence at career-relevant tasks. Correll's research shows that the cultural association of mathematical competence with boys and men negatively influences girls' self-assessments compared with boys' and raises the standard by which they judge themselves. Girls' lower self-assessment of their math ability, even in the face of good grades and test scores, contributes to fewer girls expressing preference for and aspiring to STEM careers. In this way, belief structures in the general culture influence individual choices, and those who decide to pursue STEM careers may not be those who are best qualified for careers requiring mathematical ability.

RECOMMENDATIONS

Correll's research shows that the environment and culture around girls influences their self-assessment, so her recommendations for change focus on changing the environment. As Correll explained in an interview with AAUW:

Enhancing how girls feel about themselves is very, very important, but if we don't do the flip side, and change how other people feel about girls, we're setting girls up to feel good about themselves only to encounter structures that are really pretty negative for them.

Research shows a number of direct, immediate ways to help girls better assess their math skills:

- **Schools, departments, and workplaces can cultivate a culture of respect.**

  Correll's research shows that people respond not so much to widely held stereotypes in the larger culture but to the stereotypes that are operating in their immediate environment. When institutions (including K–12 schools, universities, and workplaces) and individuals send the message that girls and boys are equally capable of achieving in math and science, girls are more likely to assess their abilities more accurately. Since schools are responsible for educating, they have a unique opportunity to help students learn new ways to interact. By teaching students to recognize stereotypes, teachers can cultivate a culture of respect in their classrooms.

- **Teachers and professors can reduce reliance on stereotypes by making performance standards and expectations clear.**

  The same letter or number grade on an assignment or exam might signal something different to girls than it does to boys. By using phrases like, "If you got above an 80 on this test, you are doing a great job in this class," teachers help students understand their grades so that students don't have to rely on stereotypes to create a standard for themselves. The more that teachers and professors can reduce uncertainty about students' performance, the less students will rely on stereotypes to assess themselves.

- **Encourage high school girls to take calculus, physics, chemistry, computer science, and engineering classes when available.**

  Correll's 2001 study showed that girls who took calculus in high school were more than three times as likely as girls who did not take calculus in high school to major in a STEM field in college. Taking higher-level science and math classes in high school keeps STEM options open.