Although more women are working in the fields of science, technology, engineering, and math (STEM), a report from the American Association of University Women entitled Why So Few? Women in Science, Technology, Engineering, and Mathematics highlights eight recent research findings that point to particular social, cultural, educational, and self-confidence factors that may be hindering some women from pursuing careers in those fields.

The eight research findings that serve as the foundation for the report are categorized as follows: beliefs about intelligence; stereotypes; self-assessment, implicit bias; spatial visualization skills; the college student experience; university and college faculty; and workplace bias.

One such finding comes from Carol Dweck, Ph.D., a social and developmental psychologist at Stanford University who has spent many years studying self-assessment and how it affects one’s own abilities. The report refers to research by Shelley Correll, Ph.D., an associate professor of developmental, social, and educational psychology at New York University, says that stereotypes are more likely to believe in the stereotype that girls have a fixed amount of intelligence, they are more likely to believe in the stereotype, lose confidence, and disengage from STEM as a potential career when they encounter difficulties in their course work,” the report states.

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Baartmans, a math educator at Michigan Technological University, to study spatial skills among women in engineering. She administered the Purdue Spatial Visualization Test: Rotations (PSVT:R), along with a background questionnaire, to 335 first-year engineering students at Michigan Technological University. An analysis of students’ test and questionnaire responses showed that previous design experiences—including drafting, mechanical drawing, and art, as well as having played with such toys as Erector Sets and Lincoln Logs—as a child—improved a student’s chance of doing well on the test. Women were more than three times as likely as their male peers to fail the test; 39 percent of women failed, compared with 12 percent of men.

With funding from the National Science Foundation, Sorby and Baartmans developed a course in spatial visualization for first-year engineering students who had poorly developed spatial skills. The goal of the course was to increase the retention of women in engineering by teaching basic spatial visualization skills, and the course covered isometric and orthographic drawing, the notation and reflection of objects, and cross sections of solids. At the end of the course, students took the PSVT:R again. The scores improved from an average of 52 percent before the course to 82 percent after it.

Each year since the course’s inception, in 1993, students who have taken it have improved their performance on the PSVT:R by more than 20 percentage points. Sorby also found that 77 percent of the women who initially failed the test and who took the spatial visualization course between 1993 and 1998 were still enrolled in or had graduated from the College of Engineering. Among the women who initially failed the test and did not take the course, however, only 48 percent were still enrolled or had graduated from that university’s College of Engineering. The course is now required for all engineering students at the institution.

While many women have the abilities necessary to succeed in STEM majors, the milieu of the academic departments at many universities—including the expectations, assumptions, and values that guide the actions of professors, staff members, and students—may make women feel unwelcome. The report looks at two research studies that support the theory that certain improvements to science and engineering departments could help retain women in STEM.

Jane Margolis, a senior researcher at the University of California at Los Angeles’ Graduate School of Education and Information Studies, and Allan Fisher, a faculty member and co-director of the University of California’s Center for Research on Women in Engineering, conducted a four-year study of women in Carnegie Mellon University’s College of Computer Science to better understand why so few women go into computer science. Between 1995 and 1999 they interviewed more than 100 students and conducted numerous times, beginning with their first semester in the computer science department and concluding when the students graduated or left the major. They also interviewed faculty members, examined student journals, and observed classes. At the beginning of the study, women constituted only 7 percent of undergraduate computer science majors and were almost twice as likely as men to leave the major.

Margolis and Fisher found that men in computer science often recounted having an intense interest in the subject at an early age, while women reported that their interest formed gradually. They also found that computer science is culturally regarded as a male preserve and that there is a perceived “right way” to work with computers, which often makes women feel like outsiders in the profession. Women who feel as though they don’t belong in computer science are more likely to be discouraged from the field than is the case with their male counterparts, research shows.

In addition to the Carnegie Mellon study, the report includes research by Barbara Whitten, Ph.D., a professor of physics and women’s studies at Colorado College, who collaborated with a team of researchers to examine what keeps women in undergraduate physics departments. In 2002 the team visited nine undergraduate physics departments in the United States. In five of them, women made up 40 percent of the graduating class, but in the other four the number of women graduates was closer to 20 percent, the national average at the time. The researchers spent two days in each department and found that the most successful departments supported activities that created a sense of inclusiveness for students of varying backgrounds. Those departments often had physics lounges and sponsored social events that enabled students and faculty members to interact and get to know one another. Improving the milieu of academic departments may not only help retain female students; it may also pay dividends when it comes to recruiting and retaining female faculty members. At present, some universities’ STEM departments have a shortage of women faculty. In a survey to improve the academic environment for junior faculty members, particularly women, Cathy Towry, a research associate at Harvard University’s Graduate School of Education, co-founded the Collaborative on Academic Careers in Higher Education in 2002. The program includes more than 130 colleges and universities that participate in the Tenure-Track Faculty Job Satisfaction Survey, which is administered annually to all full-time tenure-track faculty members at participating institutions. The survey asks junior faculty members to express their level of satisfaction regarding promotion, the nature of their work, policies and practices, and the general milieu and level of collegiality on their campuses. The survey also includes questions about the academic career of faculty members: whether they have had the chance to undergo their annual performance reviews, so that their performance was clear. The other was told that the men and women were clearly successful and had been named top performers by the organization. When performance was made explicit, participants saw the man as being more competent and the woman as being equally competent. When performance was not clear, however, the participants rated the woman as being significantly less competent than the man. Moreover, when performance was not known, the participants rated the man and the woman as equally competent. But when performance was clearly stated, participants overwhelmingly indicated that the man was more likeable than the woman. The successful woman was also rated as less diplomatic and less congenial than the successful man, while the woman was rated significantly more diplomatic and more congenial when success was ambiguous.

Based on the research findings, Why So Few? Women in Science, Technology, Engineering, and Mathematics provides a number of recommendations for engaging more women in STEM, including cultivating girls’ interest in science and engineering by exposing both girls and boys to female role models in STEM careers, teaching girls that intellectual skills can be developed, creating a healthier work environment that supports women in science and engineering, and raising public awareness of bias against women in STEM fields. The report stresses that because scientists and engineers are working to solve some of the world’s most complex problems, it is of the utmost importance that all groups of people, including women, be represented in the workplace. When women are not properly represented in STEM, their needs and desires often go unmet. Such was the case when a group of predominantly male engineers developed the first automobile air bags based solely on the size of adult male bodies. This resulted in avoidable deaths of women and children, according to the book Unlocking the Clubhouse: Women in Computing (Cambridge, Massachusetts: MIT Press, 2001), by Helene Dumas, a Carnegie Mellon alumna.

To read the full report, visit www.aauw.org/research/whysofew.cfm.