CHAPTER 2

**Why is Gender Diversity Important?**

### 2.1 INTRODUCTION

Before we jump into what you can do to improve gender diversity, we begin by explaining why gender diversity is an important goal.

There are several arguments we have heard made against actively working toward gender diversity. “We live in a country with abundant opportunities, so why are we trying to make females choose to be in a career they do not want? Shouldn't that choice be more important than whatever desire we have for those bodies to be in computer science?” and “As much as some want to believe females and males are exactly the same, there are biological differences that, for whatever reason, lead to different strengths in females and males. Since males perform statistically better on spatial tests, perhaps computer science is better suited to males.”

These arguments against gender diversity assume two things. First, females and males are treated equally. Second, since they are treated equally, there must be innate differences between females and males that cause females to either not be interested in computer science or not be equally capable of succeeding in computer science. If it is lack of interest, then who are we to try to convince females who do not want to be computer scientists that they should be? If it is difference in capability, then it would be counterproductive to do so, requiring the lowering of academic standards to achieve some artificial norm in gender numbers.

Unfortunately, there is ample evidence to show that, despite gains in gender equality in the past 100 years, females and males are treated differently by parents, teachers, and caretakers from infancy. While there is little difference in achievement between females and males in the math and sciences in K-12 schools (NCES, 2000), there is a large difference in career choices and the perception of others as to their suitedness for top-tier academic success.

In addition, while there clearly are biological differences between males and females, the evidence is very dubious as to whether any of those differences con-
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tribute to males’ and females’ success in computer science. In fact, there is as much evidence to suggest the differences make females more valuable employees than there is to suggest they are less valuable employees (which is why companies recruit under-represented minorities so heavily—it’s economics, not altruism. See Sections 2.4.2 and 2.4.4). In addition, the overlap between males and females is large enough that even if there were statistically significant differences in the average female and the average male, it would be unconscionable to apply those average arguments to any individual female or male.

Finally, the gender gap itself presents an extra barrier: the lack of females feeds the belief that females are somehow not as talented at computer science, which in turn causes females to do worse in computer science through an effect called stereotype threat. We explain what stereotype threat is and why believing that females (and other minorities) should be represented in every major is important for their success.

Let me just remind you of the limitations of these studies, which we mentioned in the Introduction. First, no statistical study represents everyone, because there is a great deal of variation within the group. When comparing males and females, the overlap is very great. Second, the successful females in computer science were successful for a reason, making them less likely to identify with these studies than the average female. In the future, we hope fewer and fewer females will identify with these studies, because that will signal that the United States is becoming more equitable in terms of the upbringing of male and females.

2.2 COMPUTER SCIENCE—THE WORST IN STEM

The media has published such positive articles about how females have caught up in academia that one might believe parity has been achieved. The number of females receiving bachelor’s degrees rose to over 50% for the first time in 2011, National Center for Education Statistics. Sure, computer science appears to be slightly behind, but one might think that, over time, progress is being achieved. It is only a matter of time.

Sadly, that is not the case for computer science. As you can see from Figure 2.1, females have been making fairly steady gains in most STEM fields. The fields with the fewest women have historically been physics and engineering, but they, too, have been steadily increasing to around 20%. Computer science, though, is an outlier. In the early 80s, computer science did very well. In fact, almost a third of
bachelor’s degrees went to females in the early 80s. Since then, though, females have chosen computer science in decreasing percentages. It was not just the dot-bomb (dot-com bust)—female representation in computer science has decreased for almost 20 years. Despite the increased effort and funding of gender diversity initiatives, females continue to flee the field.

In a more positive development, Figure 2.2 shows that universities have been successful in gradually increasing the number of female faculty members. Not surprisingly, the percentage of junior faculty has been higher than more senior faculty. We hope these trends continue. It will be difficult, however, if the percentage of females keeps decreasing at the lower levels.

As a result, we feel the most important portion of this guide is the information aimed at affecting the most females at the undergraduate level—in the classroom. However, in order to continue the positive progress at the graduate and faculty levels, we have included tips and background for undergraduate research and graduate research, faculty, and institutional-level changes.

Further reading:

* CRA Taulbee Trends: Female Students and Faculty*
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Figure 2.2: Percent Female Computer Science Faculty, as reported by PhD-granting institutions responding to the Taulbee Survey. There has been incremental but steady progress at all levels, from Assistant Professor through Full Professor. Source: Taulbee Surveys.

http://archive.cra.org/info/taulbee/women.html

2.3 THE MYTH OF CAREER CHOICE

The rights of females to equal economic access has been long fought, from Elizabeth Blackwell getting the first medical degree in 1849 to females getting the right to vote in America in 1920. Harvard Law School did not admit females until 1950. In the 1960s and 70s, teacher, nurse, and secretary were often the only careers females believed were open to them. Some now believe that because universities, medical schools, law schools, etc., no longer discriminate on the basis of gender, females are treated equally and have the same opportunities as males.

While the past 100 years has seen tremendous progress, and overt, intentional discrimination is not often an issue, girls and boys still grow up with very different roles, treated differently from infancy by parents and teachers, having vastly different expectations in many religions, and shown different sets of acceptable toys within toy stores. These differences have a profound influence on females’ career paths.

The focus of this section is to show that females and males display similar levels of capability and achievement in math and science, yet make very different
career choices. In order to show why, we focus on three points. First, females and males are expected to have different interests. These expectations, and the toys they receive, provide different experiences, providing different areas of confidence. Second, parents provide praise to daughters and sons in different ways, which lead to differences in willingness to take on challenges. Third, their levels of self-esteem are very different in high school and early college, the point at which career choices are made.

![Math and Science Scores by Gender](image)

**Figure 2.3:** Math and science scores for females and males on achievement tests in 4th, 8th, and 12th grade. There is virtually no difference in scores at any of these levels. Source: National Center for Educational Statistics, 2000.

### 2.3.1 MATH AND SCIENCE ACHIEVEMENT

There are no required computer science courses at any point in education, so we cannot do a broad comparison of female and male potential in computer science. Math and science are the closest fields, so while not perfect indicators, certainly performance in math and science gives insight as to whether there is a predicted gender difference to expect in computer science.

Figure 2.3 shows performance of American students on standardized math and science tests broken down by gender for 4th, 8th, and 12th grade (NCES, 2000). As you can see, there is no statistical difference in performance in math, and
only a slight difference in the performance in science. Achievement does not at all explain the gender gap in computer science and engineering.

Figure 2.4: The gender balance of bachelor's degrees earned in different STEM fields in 2007. Females are more likely to major in classes they took in high school, leading one to believe confidence, not aptitude or interest is a determining factor. Source: National Science Foundation, Division of Science Resources Statistics, 2009.

If we look more closely at the STEM fields, we see that not all STEM fields suffer a large gender imbalance. Figure 2.4 shows the gender balance of BS degrees in STEM fields. Mathematics, chemistry, and biological sciences have a good gender balance, whereas physics, computer science, and all engineering fields have a poor gender balance. We see that females are much more likely to major in a field that exactly matches a high school requirement than not. This is especially highlighted by the difference between chemistry and chemical engineering. They are both built on the same area, but have quite different representation.

Why is there such a difference between these areas? One aspect is interest, because biological sciences are tied to the medical field, and females have been shown to choose fields that have a large societal impact. Although computer scientists are well aware that CS has a major societal impact (e-mail, Facebook, Google), computer scientists are often portrayed by the media as tech support (annoyingly condescending to everyone else) or hackers trying to use technology for crime. Very seldom are computer scientists using their skills for the greater good (Angela in the
crime series *Bones* being a delightful counterexample). Differences in motivation do not explain the gap between chemistry and chemical engineering, nor the gap in general between mathematics and chemistry vs. the engineering and computer science fields.

We propose that this is a gap of confidence and risk-taking. The combination of high school course offerings and college entrance requirements compel students to take mathematics and choose at least two courses in biology, chemistry, and physics. Despite any differences in upbringing and influences about what females *should* do, females receive a somewhat objective, quantitative measure of their achievement in those courses, and they see that they are just as capable as their male peers. Their confidence increases in those fields, and they are more likely to major in them. Without required courses in engineering and computer science, females do not have that opportunity. Thus, majoring in those areas is a risk and requires confidence.

### 2.3.2 THE RISK-TAKING GAP

Risk-taking might be somewhat innate, but caretakers have great influence on a child’s willingness to take risks and challenge themselves. Carol Dweck of Stanford has pioneered recent work on the effect praise has on behavior. She has found in several studies that praising ability rather than effort causes children to attempt easier problems in order to reinforce their identity as smart rather than attempting harder problems to show how hard they try.

She has a new long-term study (*Gunderson et al.*, 2013)—the first to observe and measure effects in normal family interactions rather than a laboratory experiment. Her team observed the ratio between praise of personal traits (i.e., smart) vs. effort in 1-3 year olds and measured the child’s willingness to attempt challenging problems five years later. They found two results. First, the more that effort was praised, the more likely students would take on challenging problems and take risks five years later. Second, males were more often praised for their effort, and females were more often praised for their personal traits. Thus, males are being nurtured to take more risks and tackle challenges from before they can talk. This effect is shown in Figure 2.5.

In adulthood, women have been found to be more risk averse to men in 150 studies, from making financial decisions (*Jianakoplos and Bernasek*, 1998) to playing chess (*Gerdes and Granmark*, 2010). A meta-analysis
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Figure 2.5: The type of praise given to children has lasting effects 5 years later. Females are more often given praise about personal traits, leading them to reinforce that through low-risk endeavors with high-probability success. Males are more often given praise about effort, leading them to reinforce that through taking on challenges. Source: Gunderson et al. (2013).

(Byrns, Miller, and Schafer, 1999) found that studies overwhelming show a real gap between males and females. The gap is situational, more pronounced in areas such as intellectual risk taking and physical skills, and less pronounced in others such as smoking. In addition, the gender gap is shrinking over time, showing that it is neither an innate trait, nor is the gap unfixable.

Further reading:

Babies whose efforts are praised become more motivated kids, say Stanford researchers

2.3.3 THE EXPERIENCE GAP

These same children are receiving much different toys to play with. Toy stores often have toys sorted by gender, with blue sections and pink sections. Sadly, an attempt by Hamleys, London’s best-known toy store, to introduce gender-neutral signs and maps, was abandoned after eight months (Bennhold, 2012). The boys’ section has building toys such as LEGO’s, tinker toys, tool tables, and marble ramps. The girls’ section contains kitchens, dollhouses, dolls, and stuffed animals. Thus begins both the socialization of what girls and boys should do and the practice and confidence-building influencing what girls and boys can and will do.

Nobel prize winner Steven Chu (1997, Physics) says in his autobiography: “The years of experience building things taught me skills that were directly applicable to the construction of the pendulum. Ironically, twenty-five years later, I was to develop a refined version of this measurement using laser cooled atoms in an atomic fountain interferometer (Chu, 1997).”

By providing boys years of play with building toys, they increase their skills and confidence in building things, which is what we are taught is the basis for engineering. Computer science majors are very often housed in the College of Engineering. In addition, computer programming has a long history of the “tinkering” approach, very much akin to taking apart watches and radios to learn them. This entire philosophy of learning is much more similar to tactile building than it is to social play. Thus, even though there are blue computers and pink computers for girls to use, the programming of computers continues to be presented in a way that resonates with male toys.

Perhaps without this experience and confidence, girls are less likely to choose this as a major, either consciously fearing they are already years behind or merely lacking the positive experiences that provide self-efficacy in this area.

In fact, a study from Carnegie Melon University (CMU) found that most females in computer science were one of three groups: is the oldest in the family, has no brothers, or is there for economic reasons (Margolis and Fisher, 2003). For the first two cases, it is likely that the girl had more time with her father, experiencing the style of play boys typically get.

Further reading:

Unlocking the Clubhouse, Margolis and Fisher
http://dl.acm.org/citation.cfm?id=543836

1 LEGO introduced pink LEGO sets, lowering the barrier to people buying LEGO sets for girls. With LEGO Friends, the themes have changed, and perhaps this will narrow the gap for future girls.
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Toys Start the Gender Equality Rift

http://www.nytimes.com/2012/08/01/world/europe/01iht-letter01.html

2.3.4 THE CONFIDENCE GAP

By the time students enter elementary school, girls are more risk averse, and boys have more experience with engineering- and computer-related toys. We do not mean to imply these are the only differences, only the ones on which we focused. These two (and possibly other) factors reinforce themselves, building a cycle in which boys further build their skills and confidence because they challenge themselves more.

Treatment in school reinforces these differences. Teachers ask boys more questions (French and French, 1984), and the type of question is more open-ended and challenging than those asked of girls (Swann and Graddol, 1998). Thus, females have less practice with open-ended problems, leading to less confidence in these types of tasks.

As students hit puberty, confidence reaches an all-time low. Both females and males report very low levels of self-esteem (Figure 2.6). In high school, though,
the differences become striking again. The self-esteem of males begins to recover (Block and Robins, 1993), while female self-esteem continues to fall. It is at this time, when the gap in self-esteem is the largest, that males and females must make career choices.

The effect of self-esteem does not just affect overall confidence. It affects students’ perceptions of what they are good at, which in turn affects in what careers they think they would succeed. These also affect perseverance within the major, which we will address in Chapter 3.

So, despite equal aptitude in math and science, females have gaps in risk-taking, experience, and confidence in computer science and engineering fields. Females tend to choose majors in which they can make a positive impact on society (education, medical care), fields in which they stereotypically do well (writing-based humanities), or ones they have already received quantitative feedback that they can do well in (mathematics, biology, and chemistry). Unless we change the messages we are sending, or require all students to take a course in order to provide that positive feedback, we cannot expect females to choose engineering and computer science, regardless of ability.

2.4 WEIGHING GENDER DIFFERENCES

Despite females now achieving at the same level of males in math and science (as shown in Figure 2.3), some people argue that there might be a biological reason that females are not as good at engineering, and the gender gap is justified in this way. The argument is that there are clearly physical differences between males and females, so there are probably cognitive differences, as well. These might make females and males better suited to different careers.

If this were true, then businesses would not be striving so hard to increase the diversity of their work forces. Businesses are not doing this out of an altruistic sense of fairness—they care most about their bottom line. Businesses want a diverse workforce for three major reasons. First, they want their products to appeal to a diverse population, so it is important that the designers reflect the consumers. Second, regardless of what the product is, a diverse team has more variation in ideas, leading to a better solution. Finally, in teamwork, it turns out that there is some evidence that having more females leads to more productive teams. The benefits of having female engineers greatly outweighs the evidence of any biological disadvantage females may have.
It is impossible to determine, one way or another, whether females or males are better suited biologically to computer science. Teasing out the distinction between genetic/biological vs. environmental factors is extremely difficult. Instead, my goal is to present evidence that, at best, shows that females are as much at an advantage as disadvantage, and at worst, exposes reasonable doubt. We believe reasonable doubt is all that is necessary because the injustices caused by believing (and acting on a belief of) innate differences are far too damaging to be justifiable in the presence of reasonable doubt.

2.4.1 DISADVANTAGE – SPATIAL ABILITY

This subject is controversial, and scientists have a poor historical track record in their attempts to “prove” superiority of one group of people over another with respect to cognitive tests. *The Mismeasure of Man* (Gould, 1981) presents historical attempts to prove that Africans are less intelligent than Caucasians because of smaller cranial capacity. First, the scientists’ methods were compromised by their beliefs, leading them to (unintentionally?) pack the material tighter in Caucasians’ skulls. Second, cranial capacity is not the determining factor in intelligence. He further argues that even with various intelligence tests, the ties between those tests and success in certain fields are not as closely linked as scientists would like to believe.

We find ourselves in a similar position with respect to gender and computer science. Males tend to do better on spatial tests than females. Females tend to do better on “social intelligence” tests than males. The two questions, then, are whether the performance is biological rather than learned, and whether people with higher spatial rotation ability are more suited to computer science than those with higher social intelligence. Finally, we must always recognize that the overlap between genders might be larger than the differences. So even in the presence of differences in the average person, a large gender gap may not be warranted.

When making biological arguments, there are generally two schools of thought. The first is evolutionary psychology, arguing that evolution favored certain traits in females and males based on their gender roles in prehistoric times (i.e., males are better at judging faraway targets for hunting, and females are good at short-distance focusing for gathering (Stancey and Turner, 2009). The second is that the chemical differences in the bodies affect the skill (i.e., testosterone makes males stronger and more aggressive).
2.4. WEIGHING GENDER DIFFERENCES

Let’s begin by exploring the evolutionary psychology argument. The field itself, from its inception, has been controversial. Controversy about the conclusions drawn using this paradigm aside, in order for this argument to be valid, there must be a compelling reason that, based on the roles of females and males in the hunter-gatherer era, males needed spatial rotation ability more than females. At the 2012 NCWIT Summit, Dr. Nora Newcombe argued eloquently against this position (Newcombe, 2012).

Is spatial rotation ability more important for hunting than for gathering? Hunters must memorize the locations and migratory patterns of animals, coordinate attacks, and fashion weapons. Gatherers must memorize the locations of water and plants, know which plants are ripe at what time, and plan and execute gathering routes appropriate to which plants are currently ripe. While we could bicker about the details required for each task, and which requires slightly more spatial ability than the other, we think it is clear that gathering over large distances on a daily basis does not require significantly less spatial ability than hunting large game on a less-than-daily basis. Therefore, evolutionary psychology does not explain the difference in spatial ability.

The second argument is that the testosterone males have improves their spatial ability. There is variation within males and females as to how much testosterone they have. For this to be true, larger amounts of testosterone should correlate with higher spatial ability. Studies have shown mixed results. Some compare the same males as their testosterone fluctuates during the day (with highest testosterone in the morning). These show a correlation between higher testosterone in the morning and better performance on spatial rotation tests (Silverman et al., 1999, Moffat and Hampson, 1996). It is unclear whether this is caused by testosterone or general fatigue. When comparing different males, they have found an inverse correlation between testosterone levels and spatial ability (Moffat and Hampson, 1996). In females, spatial ability has been shown to reduce with an increase of estrogen (Elizabeth Hampson, 1990), when comparing the same females during different parts of their menstrual cycle. At this point, scientists do not have a unified theory. The fact that when comparing different males, lower testosterone correlates with higher spatial ability means that a large number of females with high testosterone (for a female) could be equally advantaged as males with high testosterone.

Given how inconclusive these studies are, one cannot discount the differential upbringing females and males have. In particular, the toys in the “boys section” of stores include LEGOs, erector sets, and the like. As quoted earlier, Steven Chu,
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Table 2.1: Examples of design errors due to lack of female engineers. Source: see text below

<table>
<thead>
<tr>
<th>Product</th>
<th>Shortfall</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cars</td>
<td>Lack of visibility for short drivers</td>
<td>More accidents</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative driving stereotypes</td>
</tr>
<tr>
<td>Voice Recognition</td>
<td>Did not recognize female voices</td>
<td>Unusable by females</td>
</tr>
<tr>
<td>Airbags</td>
<td>Not calibrated for short drivers, passengers</td>
<td>Unnecessary deaths of short women and children</td>
</tr>
</tbody>
</table>

1997 Physics Nobel Prize winner, credits his later success on his early childhood building experiences (Chu, 1997). By providing boys years of play with building toys, they increase their spatial skills. Girls, on the other hand, are steered toward nurturing roles, providing practice with different skills.

Finally, regardless of the reason for the difference in spatial ability, we would still need to believe that spatial ability is correlated to success in computer science for this to be a reason females are ill-suited to the field. In addition, the difference in representation should be largely similar to the difference in spatial ability. The gap in spatial ability, though, is much smaller than the gap in representation. In fact, with a little training, females are able to close this gap tremendously (Newcombe, 2012). There are more than enough jobs available for the range of spatial ability achievable when females and males receive training in spatial tasks.

Further resources:
Nora Newcombe’s 2012 NCWIT Summit Talk
http://vimeo.com/channels/372194/45873134

2.4.2 ADVANTAGE – DIVERSITY OF EXPERIENCES

The biological disadvantage of being female has certainly not been proven. There is actually much more evidence that being a female is an advantage because of their minority status as well as differing strengths. Let me be clear—we are not advocating the view that females are superior to males, any more than that males are superior to females. We are merely presenting this evidence to show that there is at least as much evidence that products would benefit from the inclusion of more females (but not necessarily more than a 50/50 split) as that products benefit from mostly male designers.

Engineers design a plethora of products that target the general population. In the design of these products, there are fundamental physical differences between
females and males that should not be overlooked (i.e., size, strength, voice) as well as tastes and preferences, that affect the suitability for females. Engineers design critical equipment such as medical devices, wheelchairs, automobiles, and air bags, for which these physical differences are important. Some serious shortfalls are shown in Table 2.1. For example, air bags were initially designed for adult male bodies, leading to preventable deaths of women and children (Margolis and Fisher, 2003). In a less critical example, the Volvo YCC was designed by women to showcase the ergonomic perspective of a female driver. Among the features were headrests with space for a pony tail, the front lowered and fenders put in view for short drivers to allow the driver to see where the four corners of the car are, and pushing a button opened the nearest door to allow someone juggling bags to easily place things into the car (Volvo, 2004). Finally, early voice recognition systems were calibrated to low male voices, making children and women’s voices unrecognizable to the system (Margolis and Fisher, 2003).

These are just a few examples of how including or excluding females from design teams can have profound effects on the usefulness of the products to 50% of the population. If companies want to design products for the general population, it is critical that females (and other minorities) be represented.

Further Reading:
Unlocking the Clubhouse, Margolis and Fisher
http://dl.acm.org/citation.cfm?id=543836
Volvo YCC details
http://www.howstuffworks.com/volvo-concept.htm

2.4.3 ADVANTAGE – DIVERSITY OF IDEAS
Theoretically, one could design a product for diverse populations, not by having the engineers be diverse, but by having a diverse set of customer consultants that the design team could interview for their feedback on design ideas. But designing for the diverse customer is just one advantage of having a diverse team. Diversity of ideas also leads to better solutions.

Why do we work in design teams rather than having a single person design a product? Because businesses for years have recognized that, in most cases, the product will be better if you have multiple people proposing ideas. The goal is not just to increase the total number of ideas, but to increase the differences between those ideas. It is not just the intelligence of the individuals that matters, but the
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Table 2.2: Just a few of the creative ideas about rental behavior. Source: van Buskirk (2009)

<table>
<thead>
<tr>
<th>Netflix contest diverse rental pattern ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekend rental behavior different from weekday rental behavior</td>
</tr>
<tr>
<td>Abrupt changes occur when people start, end relationships</td>
</tr>
<tr>
<td>People rating movies they saw long ago rate differently than ones just watched</td>
</tr>
<tr>
<td>People who rate a slew of movies at once are rating ones not watched recently</td>
</tr>
</tbody>
</table>

...diversity of the ideas. In fact, many ideas that are more different from each other can be more useful than a few excellent ideas.

This concept is not just theoretical. An amusing application of this is a recent Netflix Prize. The rough details are the following: Netflix has an annual contest to predict, based on prior ratings, what people will like. In order to win the contest, the submitted software must be 10% better than Netflix's existing software at predicting what a user will want to watch. There was a million-dollar prize for the winning team.

Different groups were competing individually, and while they initially made great strides, the improvements were stagnating. Then some teams started working together. Interestingly, the teams that contributed most to general improvements were those with algorithms that were most different from the others (van Buskirk, 2009), shown in Table 2.2.

The key to success for these algorithms is that the people in the group need to have sufficiently different ideas. Different ideas come from different upbringings, experiences, etc. Those with very similar experiences tend to have very similar ideas, which might make for a fun, positive environment, but ultimately results in a weaker outcome. It is important that we learn to celebrate the diversity of backgrounds and ideas.

**Further Reading:**

*How the Netflix Prize was Won*

http://www.wired.com/business/2009/09/how-the-netflix-prize-was-won/
2.4. ADVANTAGE – SOCIAL INTELLIGENCE

Not only is there a general argument that products are stronger with diversity of ideas, but there are research and real-world examples that show positive effects with high representation of females.

In the Lab

An intriguing study about collective intelligence (Wolley et al., 2010), as opposed to individual intelligence, explored what individual characteristics led to better group results. There has been a lot of research on individual intelligence and how performance on different intelligence tests correlates with performance solving problems. The question they wanted to answer, though, was whether performance on different intelligence tests correlated to performance solving problems in a group. Participants were found by advertising on Craigslist, and they were randomly placed into groups based on when they could make appointments to participate in the study. Participants were given individual intelligence tests, then they were asked to solve different problems as a group. The groups varied from three to five members. They then looked at a variety of factors and looked for a statistical correlation between those factors and end performance.

They found three factors that correlated with success. The first was gender. Groups with at least 40% females performed better. In addition, groups with more individuals that have high performance on the social intelligence test did well. Finally, groups that took turns speaking performed the best. Two of the three factors were correlated—females tended to have the higher social intelligence scores. Other individual intelligence tests did not have a large effect on the group’s performance.

We can only go so far with this research—in companies, people work together for many years, so a group project solved by strangers is not necessarily the closest environment to a business environment.

Further Reading:


http://hbr.org/2011/06/defend-your-research-what-makes-a-team-smarter-more-women/
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In the Real World

It turns out, though, that there is evidence even in the real world that gender can influence performance. For example, Erhardt et al. (2003) found that a percentage of women and minorities on boards of directors for 127 large US companies was positively associated with financial indicators of firm performance (return on asset and investment).

This occurs for one of two reasons—the females on the board make important contributions to the company, or a company whose culture is such that females are on the board is also a company with better female representation at all levels in the company. Either way, this implies that more female participation at the upper levels of businesses leads to financial success.

A second example deals with Wall Street superstars who switch companies. Groysberg (2010) performed a detailed analysis of the careers of more than a thousand star analysists on Wall Street. He found that performance is about more than the individual, because those who were individually lured away to another company suffered a drop in performance for an average of five years. Those whose whole units were sold to/acquired by another company showed no change in performance. When those who were individually lured away were divided by gender, it turned out that females took only an average of three years to recover prior stellar performance. This led to two conclusions. First, Wall Street performance is highly dependent on the research departments that support those stars. Second, females are better at managing and/or training those groups in a short amount of time.

Further reading:
COLLECTIVE INTELLIGENCE: “The Influence of Women on the Collective Intelligence of Human Groups,” Dr. Chris Chabris

2.5 CONCLUSIONS

In summary, we have provided evidence that:

Females may avoid computer science and engineering because of societal influences, not capabilities

• Females and males have nearly identical achievement in math and science through K-12
2.5. CONCLUSIONS

- Differences in praise is correlated to differences in the willingness to take risks and attempt challenging tasks
- Differences in toys may lead to differences in experience in physics, engineering, and computer science
- Differences in treatment may lead to differences in confidence

There is little to mixed evidence that males have any biological advantage based on spatial ability

- Evolutionary psychology does not provide evidence for gender differences in spatial rotation ability
- Biological studies are mixed on whether biological factors explain the differences in spatial rotation ability
- Domain knowledge outweighs advantage of spatial rotation ability
- No studies have shown the difference in spatial rotation ability makes a difference in succeeding in computer science
- No studies have shown that the difference in spatial rotation ability is larger than the gender gap in computer science

There is some evidence that females have advantages by being a minority and because of social intelligence

- Product teams with diverse members produce stronger products that are suited to more of the population
- Females tend to have higher social intelligence
- In a laboratory environment, females work in teams better than males
- In the real world, some examples show that females lead teams better than males

Scientific data shows that females are at least as valuable as males for computer science companies and interdisciplinary, competitive research, yet have significant hindrances to choosing computer science

Since neither side can be proven, why are we not satisfied to allow us to just agree to disagree?
2. WHY IS GENDER DIVERSITY IMPORTANT?

It is harmful for females if you behave as though you believe any of these arguments or if you perpetuate the societal stereotypes that deter females from joining computer science. You do not need to implement the majority of the suggestions. There is a wide spectrum, from being part of the problem, to being neutral, to being part of the solution. If you believe females are less capable and act on those beliefs, then you are part of the problem. At the very least, professors have a moral obligation to be neutral and give all students fair evaluations.

If you believe females have free choice of major, then you may not look and see when a female is making a choice based on low self-esteem instead of what she is capable or would enjoy. It is important that faculty members actively counteract the social forces that cause females to question their ability in computer science. We will go into more detail about this in the advising and classroom sections.

If you believe that females biologically are not as capable of succeeding in computer science, then you might be more likely to advise a female to leave the field or give subtle indicators that she will not succeed. Even if it were true, the differences within females and males is much larger than the differences between them, so this small statistical difference could not be used on any individual.

In addition, knowing the economic arguments and conveying those to students can allow underrepresented students to see the value in themselves—something they bring to the table that no one else can. This increases their feeling of worth, counteracting some of the low self-esteem.

The lack of females shapes young males' impressions that females' talents lie in staff roles, not technical roles. Male undergraduates see that the only females in the department are staff, reinforcing or creating an impression that females are not suited to computer science. When those males become managers, they may marginalize females, giving them support roles (as has been found).

Finally, the lack of females in computer science makes it harder for those there. Not just because it is lonely, not just because it is harder to find study partners. It perpetuates a negative stereotype, and the negative stereotype in itself can negatively affect performance. In a nutshell, stereotype threat is anxiety brought on by being reminded that one is not supposed to be as good in computer science. This is especially troubling because the belief that one’s group does not do as well overall causes individuals in the group to do worse.