

Gender Discrepancies through the College Years

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INTRODUCTION

Women made significant contributions to the beginning of the computing revolution. For example, Ada Byron Lovelace helped write the first subroutine, the women of the ENIAC age programmed the first computer during World War II, and Admiral Grace Hopper wrote the first compiler. While there have been female pioneers in the field, today men dominate the world of information technology (Riemenschneider, Armstrong, Allen, & Reid, 2004). Güler and Camp (2002) report that many science fields hold women in low esteem, and attempt to reject them. Moreover, women are actually declining as part of the technology workforce: they made up 41% of the information technology workforce in 1996, but in 2002 that proportion was down to 35% (Cockburn, 1999). Furthermore, the number of female university students currently studying information technology and computer science will not lead to an increase of females in the profession: in 2002, only 28% of all degrees in computer and information sciences went to women (NCES, 2003); in 2003, only 19% of computer science students were female (Wilson, 2003) and only 28% of the undergraduate students in information science were female (Saye & Wisser, 2004). In a time where women make up the majority of university students (NCES, 2003), why is information technology seeing the opposite trend (Zeldin & Pajares, 2000)?

There are a number of theories as to why so few women have chosen to pursue a career in technology (Acker, Barry, & Esseveld, 1990; Cooper & Robinson, 1985; Wilson, 2003; Zeldin & Pajares, 2000). Furthermore, nearly all studies on the subject have been done in the United States (Irani, 2004; Lips, 2004; Wilson, 2003) while only one study cited here explored the gender gap among university students at the University of Hong Kong (Huang, Ring, Toich, & Torres, 1998). A number of feminist

researchers believe that science (including technology) has a language that is masculine in nature (Acker et al., 1990). Furthermore, since our society understands gender as binary—that is, what is masculine is not feminine and vice versa—the very nature of science leaves women out. Once women get into the IT world, they face issues of personality and confidence that differ by gender.

One theory, to be explored in depth here, is that women enrolled in introductory programming courses have less confidence in themselves than do their male counterparts and that the confidence level of female students decreases significantly between secondary and post-secondary education (Lips, 2004). In addition to being shaped by their comparisons of their performance with the performance of their male peers, women's self-confidence is likely influenced by their experience of stress in their technology-oriented courses. These influences, combined with inaccurate views of IT careers, are influential in whether or not college students decide to work towards an IT-related major or choose another discipline all together (Irani, 2004; Zeldin & Pajares, 2000).

BACKGROUND

Self-perceived abilities in a given task affect performance capabilities, choices, and effort towards that activity (Zeldin & Pajares, 2000). One's self confidence, therefore, directly affects one's choice of a field of study or a career. This self-confidence, termed self-efficacy by Bandura (1986, 1997), is derived mostly from outside sources rather than the individual. In his social learning theory, Bandura (1997) posits that the most important source of influence on one's self-efficacy comes from "mastery experiences" or one's past accomplishments at a given task or in a given area of study. The second

source, and of more concern for the current discussion, is the way one perceives others performing the same task. For young women in introductory technology and programming courses, seeing their male peers as supposedly outperforming them can be quite daunting. This intellectual threat can be compared to stereotype threat, which is the idea that minorities (in this case, women) must prove themselves in order to ameliorate the stereotyped expectations of others (Steele, 1997). To overcome this threat, women must do more than men in order to be viewed as a success by society. A third source of influence on self-efficacy is verbal feedback (Bandura, 1997): positive reinforcements raise an individual's confidence levels. Finally, there is the physical and emotional condition of the individual—particularly when it comes to the effects of stress and tension. Stress and tension can lead one to feelings of failure (Zeldin & Pajares, 2000). With so many external and internal forces affecting women's self-efficacy beliefs in the male-dominated world of information technology, it is easy to see why some would choose alternatives to a technology-oriented profession.

Zeldin and Pajares (2000) critiqued Bandura's beliefs in relation to women entering male-dominated fields. They interviewed college-level mathematics students to discuss the influence that internal and external forces had on their decision to stay in the field. While Bandura argued that parents, teachers, and peers have a great influence on choices and perceived abilities, Zeldin and Pajares found that significant others (boyfriends, fiancées, husbands, life partners, etc.) for women in male-dominated fields are the most important influences for self-efficacy beliefs (Zeldin & Pajares, 2000). They concluded that not only skill-based, but both academic and relational self-efficacy beliefs caused these women to succeed.

In relation to technology, Wilson (2003) found that fewer females than males concluded that they were proficient with computers—and she studied only computer science students (Wilson, 2003). Also, more females in Wilson's study agreed that "Computers make me feel nervous." Females' low self confidence, compared with their male counterparts in technology, supports Bandura's (1986, 1997) theory that seeing how others perform at the same task and comparing one's performance to theirs can

influence one's self confidence. This finding is also consistent with interview results from Irani's study (2004). She quotes one of her participants, a female: "I have friends (that are male) who are like 'that program is so easy ...' but I know they spent a lot of time on it" (p. 197). For females in the course who do not know that the males spend a significant amount of time on a program, hearing the males' comments can be quite discouraging.

Another factor that affects women's self-perceived abilities is personality. Cooper and Robinson (1985) found that female freshman orientation students who enter male-dominated fields have characteristics very similar to those of the stereotypical male. In particular, women in male-dominated fields are similar to men in *motivation* traits (Chusmir, 1983). These characteristics relate to achievement and include: controlling, assertive, angry, and self-critical (Cooper & Robinson, 1985). These traits are what the researchers believe give women and men in both scientific and technological fields the confidence necessary to succeed in a stressful world.

Stress is another factor related to women in male-dominated fields. Irani (2004) studied students in beginning programming courses at Stanford University, interviewing them at the beginning and end of the semester to assess their feelings about the course. She was completing her research to verify that there was no inherent gender discrimination in the course, which was considered a "weeder" course. In her one-on-one interviews, a female student said that it was not talent or skill that made a better programmer; rather, it was the student's ability to deal with stress (Irani, 2004). Programming, computer problems, and network issues all exert a severe amount of stress on any person. Stress, by Merriam-Webster's definition, is a "constraining force or influence," or "a state...of bodily or mental tension resulting from factors that tend to alter an existent equilibrium." So, stress is an external force that directly affects one both mentally and physically, including effects on one's ability to perform mentally. While Irani did not exclusively study stress, she did find that it was a deciding factor in students' choices to continue their computer science studies at Stanford (Irani, 2004).

Not only do women experience more stress than men, they use different coping mechanisms (McDaniel, 2005). A study analyzing undergraduate

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