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ST 112 Science, Technology, and Society

18 May 2018

Writing Women Back into the Code of the Computer Science Field

In many STEM fields today, like biology, the percentage of women has increased over time. However, the percentage of women computer scientists has decreased. This decrease shows gender inequality within computer science is not improving. The public needs to recognize why there are less women in computer science so that women can be promoted more in the computer science field. In the past, society has negatively contributed to women involvement in computer science. People's perception in society of women and computer science has caused many stereotypes that have deterred women from engaging in the computer science field. However, society should not dissuade women involvement in computer science because women can enhance aspects of computer science through a different perspective and women should have access to the same opportunities as men. Stereotypes of gender in computer science and games system marketing have discouraged women from entering the field, but new programs and initiatives can encourage women to participate.

The decrease of women in computer science is drastic. Women's interest in computer science has declined over time and also declines throughout a woman's childhood. Over the past few decades, the percentage of women computer scientists has decreased: 37% in 1995, 24% in 2017, and projected to be 22% in 2027. In addition, the percentage of female students interested or enrolled in computing programs decreases throughout their childhood: 66% in 6-12 year old girls, 32% in 13-17 year old girls, and 4% in female college freshmen (National Science

Foundation). This continues with the high school students who took the Advanced Placement computer science test in 2013 which composed of 81.3% (25,310) boys compared to 18.7% (5,807) girls (College Board). There is a severe contrast between the number of boys and girls taking this exam. Further, fewer than 1 in 5 computer science graduates are women. These statistics show the decline in interest of women and girls in computer science which is due to both stereotypes and marketing.

Stereotypes strongly influence women and men's perception of the computer science field. The effects of computer science stereotypes are seen through one study which showed that both male and female students in U.S. secondary school in math and computer science classes perceive computer science to be a "male" dominated field. These students made their career choices based on this perception. So, female students are dissuaded from pursuing careers in computer science (Moorman & Johnson). Additionally, stereotypes have a continual and lasting effect on men and women. Dr. Cheryan, Dr. Drury, and Dr. Vichayapai, three psychologists at the University of Washington, examined computer science stereotypes influence through the brief exposure between a computer science role model and undergraduate women. One-hundred women, not majoring in computer science, interacted with either a male or female role model. In some scenarios the role model incorporated computer science stereotypes through interests explained and appearance and in other scenarios the role model did not incorporate these stereotypes. A brief interaction of 2 minutes between the participants and role models showed that role models who exemplified computer science stereotypes negatively influenced participants interest in computer science. Participants experienced immediate and long lasting negative effects. This study shows that "long-term negative effects of exposure to computer scientists who fit current stereotypes in the media and elsewhere [contribute to] current gender

disparities in computer science participation" (Cheryan, Drury, & Vichayapai 73). In both examples, the computer science stereotypes influence is evident when people choose what activities to participate in as a child and throughout adulthood. High school girls chose not to pursue classes and careers in computer science. Girls level of interest decreased when they interacted with people who embodied computer science stereotypes.

Women perceived computer science stereotypes not only from other people, but also from their physical environment. One study showed how a group's physical environment can influence a person's interest in a certain area. For example, by changing objects in a computer science class room from stereotypical computer science objects, video games and a Star Trek poster, to non stereotypical objects, like a phone book, female participants interest increased in computer science to the same level as their fellow male participants. This uncovered that objects can signify the male stereotype within computer science which prevented some women from developing interest within the field (Cheryan et al.). Since the physical environment and materials are decreasing a woman's interest than she is less likely to continue learning about computer science. This could also influence a woman's success level in computer science classes.

In addition, movies reinforced computer science stereotypes. The "gamer" stereotype of an awkward, "geek" boy who is knowledgeable about computers and is good at playing games has strongly been perpetuated through media. Movies like *War Games* and *Weird Science, Revenge of the Nerds* that came out in the 1980s use plot summaries that show that the awkward, "geek" boy who uses tech can win the girl and overcome hardship. These movies did not show girls or women actively taking part in using technology to positively influence the plot. These

examples subtly indicate to women that they should not meaningfully use technology. Beyond the effect of stereotypes in media, advertisements impacted women.

The influence of companies marketing to consumers has played a significant role on the computer science field. Most industries within the computer science field target men. This occurred because the video games industry experienced a recession in 1983. Faulty and underdeveloped video games flooded the video game market which caused the video game industry to experience a recession. Also at this time, companies marketed personal computers as gaming devices. These computers had limited word processing abilities at the time. To revitalize the industry, businesses chose to target males to sell video games and personal computers. The advertisers thought that boys and men would be more likely to buy gaming systems which was not necessarily true. So numerous companies created advertisements that targeted boys and men. For instance, the Apple II Computer TV advertisement in 1985 shows how a young boy can succeed using a computer and how he teases a young girl when she is using a computer and sabotaged her computer programing (Heaviside32). This clearly shows females viewing this advertisement that they will not succeed by using a computer which promotes men and not women to use computers. In addition, these advertisements promoted the idea that parents should buy personal computers for their sons so that the son could have fun. Advertisers did not promote this idea for daughters. Also, advertisers marketed the Game Boy Nintendo console, which revitalized the video game industry after the recession in 1983 (*Nintendo*). Nintendo did not create a "Game Girl" device and clearly stated, through the name of the device, that boys should use this console. Further, many personal computer advertisements showed the idea that by buying a computer, a man would attract more beautiful women. This occurred in the Texas Instrument advertisement in 1977 for a two-byte TMS 9900 microprocessor. The slogan on the

magazine page read “Two Bytes are Better than One” and showed two attractive women grabbing onto a “nerdy” man’s jacket and pretending to bite him (*Modern Mechanix*). This advertisement signifies to consumers that with an upgraded computer system, a man can attract more women. The focus is on a male consumer rather than a female consumer. The advertisements and marketing of personal computers and video games focused on attracting boys and men to buy the products which is important to recognize. This dissuaded women from using and purchasing personal computers and video games. These advertisements rarely showed women using computers and video games. The marketing focus on men occurred clearly through the names of products and by showing that a man with a computer could attract more women.

There are feasible actions to increase the involvement of women in the computer science field. One way to is to promote advertisements for computing and gaming devices that show women using gaming devices which will help encourage participation in the computer science field. One advertisement from Microsoft in 2016 asks young girls what female inventors they know of. The girls can only name men, but then a narrator lists significant inventions by women. The girls say that they did not notice that they only knew famous men inventors and are now more motivated to invent something that will change the world since they see the impactful inventions women have contributed (YouTube, Microsoft). Additionally, in 2017, an Apple iPad pro commercial portrayed a young girl using an iPad. She effectively used the iPad to play games, take pictures, read, and type (YouTube, Apple). This girl’s usage subtly conveys to other girls that they can use an iPad to do numerous activities. This allows girls to identify from a young age with the girl in the commercial and then, imagine how they could use the iPad. This will help to change the stereotype at a young age that usually boys use game systems.

In addition to changing advertisements, programs and organizations are needed to promote women in computer science. To influence the current trend of women in computer science, intervention of stereotypes needs to start at a young age. Childhood development is a malleable time which effects a woman's entire life. It is important that women are positively influenced to go into the computer science field. One proposed option is mother-daughter computer science clubs for elementary school girls (Moorman & Johnson). Further, Girls Who Code, Girls In Tech, and Mentor Net are influential national organizations that help facilitate programs. These organization focus on the education, empowerment, and engagement of girls and women in computer science. These programs combat stereotypes by providing girls with mentors and allowing girls to see that there are women in computer science. Also, these organizations give girls and women opportunities to learn about the possibilities within the computer science field. The progression of girls' development intellectually is a critical time and programs focusing on girls from a young age will contrast the decline in interest.

Each program takes a slightly different approach to increasing girls and women's interest in the computer science field. The Girls Who Code organization's mission is "to close the gender gap in technology" (*Girlswhocode*). Girls Who Code has become a movement that is involved in all 50 states and impacts 90,000 girls with a variety of backgrounds. Girls Who Code primarily engages middle and high school age girls. Girls Who Code focuses on furthering the learning of the students' and alumni's computer science skills, showing pathways for middle and high school girls to enter into computing jobs, and building a system of peers and role models to help the students and alumni to gain confidence and succeed. Also, the organization offers three types of programs to participate in: after school clubs for 6th-12th grade girls to delve into code, 2-week summer courses for 6th-12th grade girls on specialized computer science topics, and a 7-

week summer immersion program for 10th-11th grade girls to gain exposure to technology jobs and learn coding skills. People within the organization have been active for over six years. By introducing the possibilities of the computer science to middle school girls, girls are more likely to continue to pursue areas within computer science.

Girls in Tech influences the computer science field on a global level. It is a non-profit organization that emphasizes education, empowerment, and engagement of women. The organization primarily focuses on North America, but it also impacts Europe, Asia, South America, Africa, and Oceania. Girls in Tech The organization has many influential programs: a Catalyst Conference, Boot camps in areas such as technology, coding and design, and professional skills, AMPLIFY a startup competition for technology, Global Classroom which focuses on educating and empowering girls around the world, CODE GIT an advanced Python coding school for women professionals, Hacking for Humanity a code-a-thon where various women can gather to collaborate on advanced projects, and Mentorship programs to empower women in technology. The non-profit not only influences the computer science field, but also focuses on engaging women in other STEM fields (*Girls in Tech*). In addition, Girls in Tech has a complex and global network of jobs to increase job opportunities for women. This allows women to have access to and effectively contribute to the computer science field.

MentorNet allows women to have the chance to gain insight into the computer science field which they otherwise would not have access to. Their mission is to facilitate mentoring in computer science that "empowers individuals to persist and succeed in their fields" (*MentorNet*). MentorNet has many different levels of programs consisting of: corporate programs which connect college students with their intended workforce which helps foster relationships, college programs which connect current students with alumni from that college who are in the STEM

profession, and professional association programs which focus on virtual mentoring programs that connect students on a one-to-one basis with professionals.

Women are needed in the computer science field. Computer science is a rapidly developing field which allows for the possibility for women to shape and advance the field through job opportunities and research. Technology jobs are one of the fastest growing job markets in the country. Women should have access to and be encouraged to use the same technology and game systems as men. Also, women have the same capabilities to succeed within computer science. Society should not deter women involvement in computer science because women can enhance aspects of computer science through a different perspective. Through the recognition of why there are less women in computer science, women can be promoted more in the computer science field.

Through personal experience, I have encountered some of the influences of computer science stereotypes and marketing. I am not looking to pursue a computer science career or area of study so I have not fully experienced the extent to which women are dissuaded from pursuing the field. However, as a child, I played on the GameBoy console often and witnessed my brothers playing Call of Duty on an Xbox. I did not actively play games on the Xbox because very few games intrigued me. The video games discouraged me because the video game market targeted boys through sports games like FIFA and violent games such as Call of Duty. Also, I did notice that throughout middle and high school that computer science jobs had more men than women. Now in college, my female peers who are majoring in computer science are not dissuaded from pursuing careers, but are strongly aware of what a male dominated field they are entering into. Stereotypes of gender in computer science and games system marketing could have

discouraged me from pursuing computer science classes which otherwise might have lead me to consider a computer science career.

Stereotypes and marketing has decreased women participation in the computer science field. This occurred through the perception of computer science stereotypes within the people, physical learning environment, and media of both movies and advertising. However, through the change in advertising and organizations promoting women like Girls Who Code, Girls in Tech, and MentorNet, the number of women in the computer science field can increase. This is important because women have the same capabilities as men and can advance the computer science field. As a college student, I see my female peers pursuing computer science and know that they can enhance the computer science field just as much as men. Stereotypes of gender in computer science and games system marketing have inhibited women from entering the field, but new programs and initiatives can encourage women to engage more in the field.

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