Exploring Boundaries Between Art and Technology:
The Role of AI-Generated Art in the Traditional Art Market

Women in STEM And Its Impact on Modern-Day Technology

A Thesis Prospectus
In STS 4500
Presented to
The Faculty of the
School of Engineering and Applied Science
University of Virginia
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Computer Science

By
Yannie Wu

April 27, 2023

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

ADVISORS

Kathryn A. Neeley, Department of Engineering and Society

Briana Morrison, Department of Computer Science

The History of Women in STEM

Introduction

Technology is a traditionally male-dominated industry, and though there has been an increase in the number of women engineers over the years, the industry remains undeniably skewed toward men. As a result, there has been a lack of female perspectives in technological innovation, which has limited the potential of this field. Despite women representing 50% of the population, they make up only 26.7% of the STEM workforce (Davies, 2022). This underrepresentation has resulted in inadequate research on women's health issues, and little consideration of how technology could be designed to meet the needs of women.

Much of modern-day technology has been built around the idea of the average male. First introduced in 1975, "Reference Man" is defined as a male between 25-30 years old, weighing 154 pounds, standing 5 feet 7 inches tall, Caucasian, with a Western European or North American lifestyle. (Tapia, et al, 2021). This model is used everywhere from the automobile industry due to the healthcare industry. Therefore, many technological products and services are designed with male preferences and needs in mind.

Women were once a common sight in technology, pioneering the way as the field's earliest programmers. In fact, the first person to write what is considered the first computer program in history was done so in 1833 by Lady Ava Lovelace, a young mathematician living in England. However, the popularity of women in software was rooted in sexism as coding was viewed as a lesser job to hardware engineering. Programming was considered menial, even secretarial. Having said that, the percentage of women in computer science began to dip in 1984 and continued to drop as the years went by. Researchers discovered that while a decade earlier men and women were equally interested in coding, the advent of personal computers in the late 70s redefined the pool of those interested. (Clive, 2019). Boys were twice as likely to be gifted a personal computer as a girl, increasing their likelihood of being exposed to programming early on. Men came into college already with foundational knowledge while women were complete novices. Slowly, computers and their related topics became "for boys only."

Exploring the history of women in technology is crucial to understanding the current state of the field and how it can be improved. My research aims to bring awareness to sexism being perpetuated even in technological design to create a more inclusive and diverse industry that better serves the needs of all people.

Technical Project

Amazon EMR (Elastic MapReduce) is a cloud big data platform for running large-scale distributed data processing jobs, interactive SQL queries, and machine learning applications. (Gilmour, et al, 1986). Customers benefit from using EMR since it can quickly process large amounts of data. With the help of Amazon S3's scalable storage and Amazon EC2's dynamic stability, EMR provides stability and power for a fraction of the cost of traditional on-premises solutions. A framework that EMR comes configured with is Spark, which is used for memory caching and fast analytic queries. Every time a Spark job is run on an EMR cluster, a log report

is generated and automatically stored in an Amazon S3 bucket. These logs are generated regardless of if a job was successful or not and contain all the details engineers need to troubleshoot problems. Apart from accessing log reports through the S3 bucket, AWS provides a Spark History Server that displays log analytics. However, both methods of troubleshooting are time-consuming, inefficient, and unintuitive to the average user. To address this issue, I created a Spark Jobs Dashboard that displayed log analytics in an easily consumable manner. The steps I took to create the final product are as follows. First, I used AWS Lambda to create a function that was executed every time a new file arrived in a specified S3 bucket. The function parsed the log and inserted its data into Amazon OpenSearch, which is an open-source search and analytics tool. Lastly, I used OpenSearch Dashboard to organize and visualize the data stored. During the process, I interviewed Spark engineers and learned how to troubleshoot Spark jobs using existing methods to identify areas my solution could improve upon. While the backend work for this project was completed, the frontend work is still in development.

Preliminary Literature Review & Findings

The term "gendered technology" refers to the association of technology with primarily one sex. In most cases, gendered technology is geared toward men.

In the automobile industry, a female crash test dummy does not exist. Its absence has led to deadly consequences, considering female drivers are 17% more likely to be killed and 73% more likely to be seriously injured. Aside from differences in shape and size, the pelvis, neck, and bones of females and males have different structures and strengths. When cars are designed to pass crash tests made only for men, they fail to meet the higher standard needed to protect the other half of the population. (Keith, 2019). Women have also been excluded from medical research for decades. Today, researchers often choose to conduct clinical trials on only male subjects with the reasoning that the female cycle and hormones introduce too many variables into a study to be able to gather accurate data. Research bias has led to prescription drugs being released into the market that cause serious health risks in women. Diseases also show up differently in men than women, causing many women to be either misdiagnosed or undiagnosed. (Jackson, 2019).

(Casad, et al, 2020) conducted a study on gender inequality in academia due to underrepresentation and stereotypes, lack of a supportive social networks, and chilly academic climates. The study suggested that the Science Foundation-funded ADVANCE target changes such as mentoring and promoting women faculty networks.

(Martin, et a, 2023) studied the impact of de-gendering technology, which companies have been reluctant to implement. The research found that while gender-neutral technology may decrease stereotyping, it may also impede anthropomorphism, resulting in decreased attachment to products.

STS Project Proposal

STS stands for science, technology, and society. It examines how people create new knowledge and technologies because of political, social, and economic influences. STS is

important because it teaches engineers to make informed and ethical decisions in the workplace. Designing with this approach in mind holds engineers responsible for the impact their work has on the world. My project is an STS project because it brings awareness to the consequences of having a narrow perspective in the engineering field. It examines the ethicality of designing with no consideration for inclusivity.

I am approaching this from both a gender study focus and an ethics focus. First, I want to learn more about why there are far fewer women in the STEM field. I'd like to explore obstacles they face in entering the field, how they are impacted by a history of discrimination, and future steps that can be taken to ensure increased diversity in the workplace. Second, I want to analyze specific examples of how limited diversity in technology has greatly shaped the way we approach innovations in STEM. How ethical is it to create technology knowing that it is not designed for a large part of the population? Caroline Criado Perez is author of *Invisible Women: Data Bias in a World Designed for Men*, where she investigates the root of gender inequality in research and its impact on technological design in the modern world. (Porhour, 2022). Isis H. Settles is a psychology professor at Michigan State University and examines how individuals navigate multiple identities, with a focus on women in STEM. Her piece published by the American Psychological Association explores the cultural factors, social norms, gender stereotypes, and discrimination that cause the gender gap in technology. (Settles, 2022). These authors provide insight into the obstacles preventing women from entering the STEM field and technological consequences of such bias.

I will be using standpoint epistemology to analyze the relationship between gender and technology. Standpoint epistemology argues that knowledge is always situated within a particular social context, and that the perspectives of marginalized and oppressed groups provide valuable insights into the workings of society. American physicist Evelyn Fox Keller was influential to standpoint theory in her argument of how gender produces different scientific "postures." (Pierre, 2014). This theory is supported by the book "How Users Matter, The Co-Construction of Users and Technology," a collection of essays with a feminist focus that looks at the capacity of users to shape technology. Not only are artifacts designed with "everybody" in mind often unconsciously biased toward a single-sided male user due to designers being mostly males themselves, but they can also serve as actors with gender scripts. During the development of shavers, the female shaver had no visible screws, included perfume, and was presented as part of a beauty set. On the other hand, the male shaver intentionally made its internal technology visible and was marketed for its technological innovation. In this way, the shavers reflected the dominant idea that women were technophobic and that "to feel technical competence is to feel manly." (Pinch, et al, 2005). I intend to use this theory to identify how gender inequality has shaped the development of technology. This viewpoint will guide my research of the impact of gender relationships on the knowledge that is produced, which aligns with the STS idea of how technical and social systems are tightly interconnected.

I intend to use the research method of literature review by compiling existing papers that dive into systematic biases that have shaped the history of women in STEM and evaluate the

consequences of gendered technology. By reviewing literatures of these topics, I hope to gain insight into the relationship between gender and innovation.

Barriers & Boons

A potential limitation is the time constraint. There is a lot of content to cover across multiple topics, since I am studying both the systematic discrimination of women in STEM and its unintended consequences. There is also a financial barrier since many published journals are behind a paywall. To counteract these obstacles, I will improve my time management so that I can cover more material and reach out to authors for access to their work.

References

Davies, Katie. "Women in STEM Statistics." *Stem Women*, STEM Women Limited, 3 Nov. 2022, https://www.stemwomen.com/women-in-stem-percentages-of-women-in-stem-statistics#:~:text=Women%20now%20make%20up%2046%25%20of%20the%20total%20science%20professional%20workforce.

Tapia, Andres, et al. "The Invisible Power of the Reference Man." *Korn Ferry*, Korn Ferry, https://infokf.kornferry.com/rs/494-VUC-482/images/The%20invisible%20power%20of%20the%20reference%20man.pdf.

Thompson, Clive. "The Secret History of Women in Coding." *The New York Times*, The New York Times, 13 Feb. 2019, https://www.nytimes.com/2019/02/13/magazine/women-coding-computer-programming.html.

Gilmour, J. B., et al. "EMR." *Amazon*, Amazon, 1986, https://aws.amazon.com/emr/.

Barry, Keith. "The Crash Test Bias: How Male-Focused Testing Puts Female Drivers at Risk." *Consumer Reports*, Consumer Reports, 23 Oct. 2019, https://www.consumerreports.org/car-safety/crash-test-bias-how-male-focused-testing-puts-female-drivers-at-risk/.

Jackson, Gabrielle. "The Female Problem: How Male Bias in Medical Trials Ruined Women's Health." *The Guardian*, Guardian News and Media, 13 Nov. 2019, https://www.theguardian.com/lifeandstyle/2019/nov/13/the-female-problem-male-bias-in-medical-trials.

Casad, Bettina J., et al. "Gender Inequality in Academia: Problems and Solutions for Women Faculty in STEM." *Journal of Neuroscience Research*, vol. 99, no. 1, 2020, pp. 13–23., https://doi.org/10.1002/jnr.24631.

LY, Porhour. "Invisible Women: When You Only Design for 50% of the Population." Medium, UX Collective, 7 Mar. 2022, https://uxdesign.cc/invisible-women-when-you-only-design-for-50-of-the-population-6738f5b60b88.

Settles, Isis H. "Women in STEM: Challenges and Determinants of Success and Well-Being." *American Psychological Association*, American Psychological Association, Oct. 2022, https://www.apa.org/science/about/psa/2014/10/women-stem.

Pierre, J. "Standpoint Theory." *The Eugenics Archives*, 29 July 2014, https://eugenicsarchive.ca/discover/tree#!

Martin, Ashley E., and Malia F. Mason. "Hey Siri, I Love You: People Feel More Attached to Gendered Technology." *Journal of Experimental Social Psychology*, vol. 104, 2023, p. 104402., https://doi.org/10.1016/j.jesp.2022.104402.

Trevor Pinch and Nelly Oudshoorn. 2005. Materialized Gender: How Shavers Configure the Users' Femininity and Masculinity. In *How users matter: The co-construction of users and technologies*. Cambridge, MA: MIT Press.