

Eliminating Bias in Computer Science Education Materials

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Roadmap

- > **Motivation**
- > **Representation**
- > **Imagery**
- > **Language**
- > **Summary**

Introduction

- > A known problem in Computer Science: Low female participation.
- > We looked into CS instructional materials and looked for subtle biases that may lead to the promotion of gender inequality.
- > Specifically: **Representations** of Gender, Stereotypical **Imagery**, and Male-Centered **Language**
- > Where to look for such biases: research papers and textbooks.

Approach

- > We used a multidisciplinary perspective to examine profound, but often subtle portrayals of gender bias within the course materials and reveal their underlying pedagogical causes.
- > For each category (representation, imagery, language), we presented a **Gender Equitable Approach**: A simple alternative that does not contain the bias.
- > **The Goal**: Awareness of these biases can influence educators to more carefully select their methods for presenting information.

Representation

Cryptography Classical Example: Alice sends a message to Bob.

Representation

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- > Eve, eavesdropper**
- > Trudy, intruder**
- > Wendy, whistleblower**
- > Sybil, pseudospoofing attack**
- > Grace, Mallory, Faythe...**

Representation

Cryptography Classical Example: Alice sends a message to Bob.

> **Eve, eavesdropper**

> **Trent, trusted arbitrator**

> **Trudy, intruder**

> **Walter, protective warden**

> **Wendy, whistleblower**

> **Sybil, pseudospoofing attack**

> **Grace, Mallory, Faythe...**

Representation

A Gender Equitable Approach: Use animals

- > Eve the 'eavesdropper' with an owl who 'watches'**
- > Sybil, who assumes numerous forged identities to launch this form of attack, with a chameleon that changes colors and assumes varying identities**
- > Mallory, the perpetrator in man-in-the-middle attacks, with a sneaky snake**

Imagery

Image of Lena- used in image processing and related areas

“the Lena image is a picture of an attractive woman. It is not surprising that the (mostly male) image processing research community gravitated toward an image that they found attractive.”

Imagery

Perceptions of Self

Stereotypical and sexualized imagery affects women's perceptions of their own abilities. Lowers women's intellectual confidence.

As a result, performance also decreases.

Imagery

Perceptions by Others

Men and women perceive females as less intelligent after exposure to objectifying images of women.

Imagery

Implications

Stereotyping and objectification decrease women's confidence.

Prior studies show that confidence is key to CS success for all students, "identity of competence"

By using such images, CS educators may deter women's likelihood to succeed in the field.

Imagery

Case Studies

“[I was] struggling to believe that I belonged in a male-dominated computer science class. I tried to tune out the boys’ sexual comments...as a result, some young women are deciding not to pursue upper-level computer science courses.”

“I was literally the only female in this classroom with 30 men. They open their textbooks and there’s Lena, and all the men start giggling. You just feel like, ‘Oh, my gosh, this woman is being materialized (in a textbook)...’ ”

Imagery

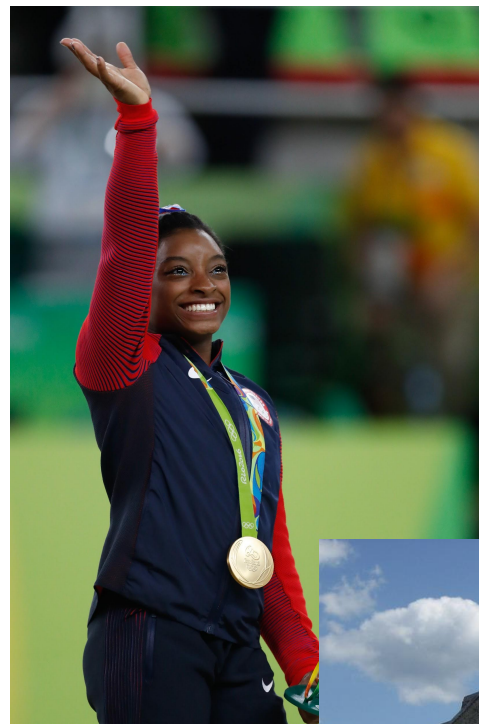
A Gender Equitable Approach

- One used prior (reverse objectification)

Our Approach

→ Gender Neutral Imagery (monument, landscape)

→ Empowering, Counter-Stereotypical Imagery



Language

The Generic *He*

- The generic *he* reinforces and perpetuates gender inequality.

In the English language, there is no singular pronoun that refers to both he and she. Thus, writers and speakers must make a choice about how they will address unspecified people: he, she, he or she, or the singular use of they.

Language

Computer Science Textbooks

- *“The problem is this: Anyone, no matter how unskilled, can design a cryptographic primitive that he himself cannot break. This is an important point.” (pg. 116)*
- *“...He’s already inside the system he wants to attack, so he can ignore any perimeter defenses around the system. He probably has a high level of access, and could be considered trusted by the system he is attacking.” (pg. 47)*

Language

Computer Science Textbooks

- *“Let’s start with an analogy. In order to steal something from your local 7-11, you’re going to have to get past the sales clerk. This clerk isn’t a creative thinker. In fact, she will only do what her employee manual says she’s supposed to do... She gives us all the money in the register and turns to the next page. We can tell her we don’t want to buy anything, and leave. If the 7-11 clerk is really as dumb as a computer system, we can get away with it... By slipping a page into her employee manual, we can give her arbitrary instructions.” (pg. 207)*

Language

Computer Science Textbooks

- *“He who would distinguish the true from the false must have an adequate idea of what is true and false.”*
- *“Once a **person** has understood the way variables are used in programming, he has understood the quintessence of programming.”*

Language

A Gender Equitable Approach

- *Alternating the use of 'he' and 'she'*
- *The use of 'he or she'*

Our recommendation: The Singular 'they'

*Example: "Once **a person** has understood the way variables are used in programming, he has understood the quintessence of programming."*

Becomes →

*"Once **a person** has understood the way variables are used in programming, they have understood the quintessence of programming."*

Summary

- > Through the careful examination of Representation, Imagery, and Language, we have described some causes of gender bias portrayals in traditional Computer Science teaching approaches.**
- > Some existing practices are harmful to female students by decreasing their confidence, perpetuating stereotypes, and failing to proportionately include them in discourse.**
- > We offered gender equitable, alternative multidisciplinary approaches that we believe will eliminate considerable bias.**