THE EFFECT OF PLURALISTIC IGNORANCE ON WOMEN'S INTEREST IN S.T.E.M. FIELDS

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Although women earn 50% of all bachelor's degrees in the United States, they earn less than 20% of computer science and engineering degrees. There is much research focusing on the lack of women in science, technology, engineering, and mathematics (STEM) fields, but research has yet to investigate the role of pluralistic ignorance in women's avoidance of these fields. Pluralistic ignorance occurs when individuals privately reject a norm, but publicly support it because they assume the majority of other people support the norm. This project examines relationships between one's views and the stereotypes they believe their friends hold regarding computer programmers and interest in computer programming. It was predicted that participants would engage in pluralistic ignorance, which would affect interest in computer programming. Additionally, it was predicted that women would engage in pluralistic ignorance to a greater degree than men, or alternatively, that men and women would engage in the same level of pluralistic ignorance, but this would have a greater impact on women's interest in computer programming. Significant trends were found for women perceiving that their friends hold more stereotypical views than men, and between men's perceptions of their friends' stereotypes and their interest. No relationship was found between women's views and women's interest in computer programming.

Women are well represented in collegiate level education. For example, in 2008, women earned 57.4% of all bachelor degrees awarded in the United States. However, women are underrepresented in science, technology, engineering, and mathematics (STEM) fields. That same year, women earned only 17.7% of all computer science bachelor degrees and only 18.5% of all engineering bachelor's degrees awarded in the United States.[1] In 2006 women earned only 13.4% of all bachelor degrees awarded in engineering technologies.[2] Women's underrepresentation in computer science and engineering fields presents costs to both women who do not pursue careers in this vital and

critical field as well as to the development of this discipline already lacking diversity of perspective. For these reasons, it is important to determine the barriers preventing women from pursuing education in the STEM fields.

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There is an abundance of multi-disciplinary research that helps to shed light on why a gender gap exists in STEM fields. Some researchers favor cultural explanations citing that men are socialized to embrace STEM careers while women are deterred from choosing them. Others support biologically-oriented factors such as men having superior spatial-abilities needed for these careers. Regardless of the source of the gender gap, most researchers have found it is evident among children for interest in STEM disciplines.[3] For example, although boys and girls in preschool have similar interests in computers, a gender gap in how they perceive people in STEM careers emerges as early as elementary school.[4] When asked to draw a typical scientist, an analysis of kindergarteners through fifth graders revealed that boys almost never drew female scientists and only .5% of the drawings from both genders were of female scientists, despite the sample being half (49%) girls.[5] In addition, boys tend to have greater accessibility to resources such as computers than girls, which results in a decreased level of interest in STEM fields for girls.[6,7] Boys are also given more encouragement toward technology and other STEM fields than girls.[8,9,10]

One issue of particular interest for my thesis is that stereotypes about computer science and computer programming are often somewhat negative. Undergraduate students report they think of typical computer science majors as men who possess low social skills, are introverted, reserved, and not interested in sexual relationships with others, and have a high need for achievement, order, and consistency.[11] Computer science students and professionals are also thought of as "geeky".[12] All of these traits are seen as less desirable in social situations. However, given the ubiquity of technology and computers in society, I suspect many women as well as men are interested in computers and STEM fields. Those who are interested in STEM fields as a career may not pursue them because they are aware of the stereotypes concerning computer science individuals. Although interested individuals may not endorse or fit into such stereotypes, fear of judgment from their

peers could prevent these individuals from pursuing careers in STEM fields. My thesis examines how men and women view people in computer science and, further, how they think their friends view people in these fields. I examine whether people believe there is a larger difference than actually exists between their own views of people in computer programming and the views their friends hold. My thesis also explores whether this perception leads women to show lower interest than men in computer programming.

Pluralistic ignorance occurs when a majority of individuals privately reject a norm, stereotype, or idea but publicly support it because they mistakenly assume that the majority of other people support the norm.[13] I propose that a majority of individuals believe their friends hold more stereotype-based views of people in computer programming than they personally believe. Individuals may hide their interest out of fear of being thought of as geeky, introverted, lacking social skills, and generally fitting the negative computer programmer stereotype.

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Individuals, especially women, may fear judgment from their friends over pursuing interests in computer programming. This fear may result from the perception that one's friends hold stereotypes regarding computer programmers that are more negative. Therefore, I expect women do not differ as much from men in their interest in computer programming as one might guess, given the gender gap in these careers. It is possible women do not agree with rigid stereotypes about computer programming, but falsely believe the majority of their peers do hold this view of people in computer programming. They might set aside their interest in computer programming in order to mask what they perceive to be a difference in attitudes between themselves and others. If students who do not identify with the stereotypic computer programmer shared their interest in programming with their peers, they might discover other students who also do not fit the stereotype yet share and interest in computer programming.

In this study, participants' own views regarding the stereotypes about computer programmers were compared to what they said about the views that most of their friends likely held. I hypothesized that participants would show signs of pluralistic ignorance in that they would say their friends hold more stereotypic views of computer programmers than they did. If this is true, it is expected that the amount of pluralistic ignorance people show will

correlate with the amount of interest they have in the field.

To account for the gender gap in STEM fields, two potential explanations are proposed. First, it is possible that women engage in pluralistic ignorance to a greater degree than men. If this is the case, a larger difference in women than men is expected when comparing reports of their own beliefs about computer programming and how they think their friends view people in that field. Alternately, it is possible that men and women engage in the same amount of pluralistic ignorance, but this error has a larger impact on women's interest in computer programming than it does on men's. If this latter theory is true, no difference in how men and women view computer programmers or how they say their friends view people in this field may be found, but there might be a higher correlation between men's and women's pluralistic ignorance and their interest in computer programming.

Method

Participants

One hundred participants (46% men) participated in this study in exchange for $0.50 through Amazon Mechanical Turk (Mturk). MTurk is an online marketplace that allows users to complete online surveys and studies for monetary compensation. All participants were U.S. citizens, and they ranged in age from 19 to 65, (mean age =33.6, SD = 12.0). They were 83% White, 8% Black, 3% Hispanic, 2% American/Indian/Alaskan Native, 4% Asian, and 1% other.

Procedure

Participants first provided demographic information, including their student and professional status. Participants were then asked to rate 16 specific characteristics with respect to how well they described individuals who are interested in computer programming. Participants answered these questions using a 7-point scale ranging from Strongly Agree to Strongly Disagree. Five of the characteristics were meant to reflect stereotypes about computer programming (nerdy, interested in science fiction, intelligent, shy, and socially awkward). The remaining 11 characteristics were filler items (strong, warm, and honest) designed to reduce focus on the measures of interest. This first set of questions was designed to measure participants' endorsement of computer programming stereotypes. Participants then answered 16 parallel questions designed to measure their perceptions of how much their friends endorse computer programming stereotypes.

Finally, the participant completed a questionnaire assessing their general interest in computer programming. Participants answered three questions designed to measure the participant's own interest in computer programming ("I enjoy learning about and participating in computer programming," "I find computer programming interesting," and "I like tinkering with computers and learning about how they work"). Participants also answered these questions using the same 7-point scale.

Results

Two participants were outliers and were removed from all analyses, which left a sample of 101 participants. To determine if participants demonstrated pluralistic ignorance regarding beliefs about computer programming, I calculated the average of how strongly participants associated stereotypical traits with computer programmers ($\alpha=0.79$). I then calculated the average of how strongly participants thought their friends would associate the same stereotypical traits with computer programmers ($\alpha=0.86$).

Influence of Gender
on Pluralistic Ignorance

A 2 Gender (male vs. female) x 2 Target (self vs. friends) repeated measures ANOVA was conducted to determine if participants' own beliefs differed from expectations of their friends beliefs in the stereotypical traits they associated with computer programmers. This analysis revealed a significant main effect of target, $F(1,99) = 8.65$, $p < 0.005$, indicating that participants offered less stereotypical ratings of computer programmers when describing their own views than when reporting what they expected their friends think. This provides some initial evidence that pluralistic ignorance does exist regarding prevalence of stereotypes about computer programmers.

The repeated measures ANOVA indicated no interaction between gender and target, $F(1, 99) = 0.36$, $p = 0.55$. This suggests men and women did not differ in the amount of pluralistic ignorance that they showed. There is no difference in the degree to which men and women perceive they hold less stereotype-based views of computer programmers than their friends (Table 1).

A set of t-tests was conducted comparing the individual cells to better understand the data. These analyses revealed marginally significant differences between men and women suggesting that women expect their friends' views of programmers to be more stereotypical than do men, $t(99)=-1.17$, $p<0.10$. While there was no significant difference between men and women in their

own views, the difference that was evident shows that women's views were more stereotypical than men's views. This suggests that women might hold more stereotypical views than men, t(99)=-1.03, p=0.30.

Pluralistic Ignorance and Gender's Influence on
Interest in Computer Programming

Looking at male participants, there is no correlation between how stereotypically they view computer programmers and how interested they are in programming, r(48)=0.11, p =0.48. There is, however, a significant positive correlation between how stereotypically they think their friends view programmers and their own interest in programming r(48)=0.30, p <0.05. This provides some initial evidence that the more that men believe their friends hold stereotypical views regarding computer programming the more interest they express in computer programming.

Survey Scores

	Own Views	Estimated Friend's Views	Friends-Self Difference
Men	4.77	4.95	0.18
Women	4.98	5.25	0.27

Raw data averages for men and women, and the difference between individual/percieved views.

Looking at female participants, there is no significant correlation between their interest in computer programming and the stereotypical nature of their beliefs, r(53)=-.11, p =.43. There also is no significant correlation between their interest in programming and their perception of how stereotypically their friends view programmers, r(53)=-.12, p=.38. However, to the degree that there is a correlation between these measures and women's interest in computer programming, it is in the predicted negative direction. Although the correlation does not reach significance, there was a weak pattern in the data suggesting the more women thought their friends held stereotypic views, the less interested women were in computer programming.

Discussion

In this study, evidence of pluralistic ignorance, defined as thinking one's friends hold more stereotypic views than one's self, was found regarding computer programmers. I proposed two potential ways in which pluralistic ignorance might relate to a gender gap in computer programming interest. The first was

women would engage in pluralistic ignorance to a greater degree than men, and the level of pluralistic ignorance one holds would predict interest in computer programming. While I did find a marginal trend of women perceiving their friends held more stereotypical views of programmers than was perceived by male respondents, I did not find a significant difference between men and women in the prevalence of pluralistic ignorance. This study did not support the hypothesis that the difference between the respondents' own views and what they expected their friends believe would be larger for women than for men.

The second potential pattern that was suggested was both men and women would engage in pluralistic ignorance to the same degree, but this error would have a larger impact on women's interest in computer programming than men's. If this were true, I would expect to see a greater negative correlation between women's perceptions of their friends' views and their interest in computer programming than between the same correlation for men. Although not significant, there was more support in the data for this pattern than for the previous pattern. There was no significant correlation between the stereotypical nature of women's own views and their interest in programming. There was also no significant correlation between women's perceptions of their friends' views and their own interest in computer programming. However, this latter correlation was negative, as predicted, for women yet positive and significantly correlated for men.

The current findings support the idea that pluralistic ignorance plays a role in the gender gap in computer programming. Although pluralistic ignorance appears to exist in both men and women, I found evidence of a significant relationship between beliefs about friends' views and interest for men. The current findings suggest that, for women, believing friends hold more stereotypical views regarding computer programmers might decrease interest in programming. But for men, believing friends hold stereotype-based views was actually associated with increased interest in programming.

It is important to keep in mind that causation was not addressed in this study. Therefore, we do not know whether, for men, a belief that their friends hold more stereotypic views regarding computer programmers causes them to be more interested in programming. This study also did not include measures of other variables that might be causally related to both men's interest in programming and their beliefs about their friends' views.

Assuming this finding replicates in future research, it is plausible men who reported greater interest in computer programming are also involved with programming and have hobbies or careers relating to computers.

Because a majority of the stereotypes surrounding computer programmers are negative in nature, it is possible these individuals are treated negatively due to being perceived as "nerdy," "socially awkward," or showing an interest in programming.

If the men who reported an interest in computer programming have been treated negatively because of their interest, they may believe that their friends and peers think of computer programmers more stereotypically than they actually do.

I also found a marginal trend where women, more so than men, believed their friends hold somewhat more stereotypical views of computer programmers. Although the support is weaker than expected, this pattern might suggest women think their friends hold stronger stereotypes regarding computer programmers than they actually do. If those interested in computer programming encountered a negative social situation where they were treated negatively for being interested in computer programming, they may perceive their peers or friends as holding more stereotypic views than they actually do. This might lead women to hide their own interest in this field. One necessary step for future research would be to examine how treatment by one's peers impacts people's expectations about what their friends believe. Negative treatment of those interested in computer programming could be experimentally manipulated in order to show that increases in negative treatment cause beliefs that one's friends hold more stereotypical views of computer programmers than they actually do.

This study finds pluralistic ignorance exists for men and women regarding computer programmer stereotypes. However, evidence was not found that there is a stronger relationship for women than men between pluralistic ignorance and interest in computer programming. A relationship was found between participants' expectations regarding their friends' beliefs and their own interest in programming. The direction of this relationship differed between men and women. The correlation between men's interest in programming and perceptions that their friends view programmers stereotypically was unexpected and worthy of further research to better understand. While women's interest in programming did not correlate with their own views of programmers or their expectations regarding their friends' views, women should continue to be encouraged to pursue their interest in STEM fields. The factors that account for the gender gap in STEM fields need to be identified and studied so women will be better represented in within the community.

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