Title

Women in STEM: Effects of gender and occupation in biased perception of professionals

Abstract

Research shows that female professionals are viewed more negatively than males (Abel & Meltzer, 2007), and are more likely to experience gender discrimination in male-dominated careers (Bobbitt-Zeher, 2011). This is especially relevant to Science, Technology, Engineering, and Mathematics (STEM) professionals. People tend to associate STEM occupations with masculinity more than non-STEM jobs (White & White, 2006). According to role congruity theory, women in masculine jobs have occupations incongruous with gender expectations, potentially increasing bias against them (Clow, Ricciardelli, & Bartfay, 2015).

There is limited literature regarding the role of sexism in predicting attitudes toward women in stereotypically masculine jobs. The current study investigated how a professional's gender and their occupation's stereotypical masculinity affected participant perceptions and the role of ambivalent sexism in predicting those attitudes. Specifically, the researchers predicted that participants would view women and men in gender-incongruent occupations more negatively. Participants read one of four vignettes and completed a survey assessing their views of the professional and degree of ambivalent sexism. The vignettes differed on gender (male vs. female) and job-type (doctor vs. school teacher). Based on 290 participants, the results indicated that there was no main effect of gender or occupation or an interaction between them on perception of the professional.

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Literature Review

Despite efforts to reduce workplace inequality, research indicates that gender-based bias against professionals persists. The negative impact of gender bias starts long before women enter their careers: students in the humanities, especially women, had implicit expectations for females to be worse at math than males and had lower math grades than engineering students with fewer stereotypical beliefs (Smeding, 2012). These stereotypes continue on to affect women during the hiring stage: in a study by Bobbitt-Zeher, female job applicants were seen as less competent for a leadership position than male applicants of similar qualification (2011). These findings are supported by numerous studies examined in this review, suggesting a consensus that gender discrimination remains an issue in the workplace.

Evidence of Gender Bias

The issue of gender bias, particularly in STEM, is evidenced in numerous studies. For instance, research indicates that such bias occurs not only in STEM fields, but also in academia. Moss-Racusin and colleagues found that STEM educators preferred hiring a male student for a lab position over an equally qualified female student (2018a). This finding suggests that STEM educators may provide female students with fewer opportunities in STEM even before they enter the workforce; however, educators themselves are not exempt from gender bias. Abel and Meltzer compared student responses to identical lectures discussing gender bias, delivered by either a male or female professor (2007). While participants did not rank the professors differently based on their perceived knowledge or likeability, they tended to view the female professor as significantly more sexist and assigned her a more negative evaluation.

Social Role Theory

In early research into gender bias within the workplace, many professionals viewed the differing social roles of men and women as the root of gender discrepancies in certain fields (Eagly & Karau, 2002). This explanation is known as social role theory, as discussed in Eagly's early writings in the 1987 publication *Sex Differences in Social Behavior: A Social-Role Interpretation*. Contrary to beliefs in the early 1980's, Eagly suggests that there may be some credibility to the idea of inherent differences between men and women. Specifically, she asserts that, while previous research tended to support more similarities than differences, the social perception of men and women as different may be based on some evidence that research methods of the time were incapable of detecting. Alternatively, Eagly suggests that researchers may even be denying findings that potentially support the existence of sex differences to avoid ideological backlash related to the feminist movement, and insists on adhering to a data-based, scientific approach detached from ideological arguments (1987). In other words, while Eagly supports the social role explanation for gender differences, she allows for the possibility that biological differences may play a role.

Support for the social role theory explanation for gender differences is derived from the idea that, while biological sex differences may be an influence, much of the way that men and women are treated differently results from differing social roles (1987). It is difficult to establish the direction of this influence; in fact, these social expectations and sex differences may mutually affect one another in a sort of self-fulfilling prophecy. Even so, Eagly limits her discussion to how sex differences in social roles affect behavior at home and in the workforce. For instance,

she discusses how women and men tend to conform to differing social expectations because of normative influence. This idea is supported by research indicating that men are seen as exhibiting assertive and ambitious behavior while women exhibit gentleness and emotional expression (1987). Social role theory holds that men and women conduct themselves differently as a result of these differing perceptions. Therefore, when social norms dictate that men should be in positions of authority and women should be caretakers, it follows that there would be a higher amount of men seeking higher-pay jobs that involve leadership and more women caring for children at home or seeking jobs that serve others. Specifically, many researchers at the time thought that the gender gap in employment might be due to spending too much time on responsibilities within the home or that women simply did not have the drive to occupy the same positions as men in the workplace (Eagly & Karau, 2002).

Role Congruity Theory

With expanding research into potential explanations for gender differences in the workplace, additional theories have emerged (Eagly & Karau, 2002). While modern gender bias research tackles a variety of situations, much of these studies share a common theme in how data are interpreted: role congruity theory. Proposed by Eagly and Karau in 2002, this theory holds that gender bias against women results at least partly from role incongruity. In other words, women in positions incongruous with female gender role expectations are seen more negatively than men in the same occupation. This approach expands upon the initial social role theory as it allows for the gender employment gap in certain professions to be influenced by social expectations outside of a person's own choice; while some people may choose an occupation that

aligns with their assigned gender roles, others who want to pursue a career incongruous with gender norms may be subject to gender bias and discrimination. In summary, Eagly and Karau aimed to determine whether gender bias could also contribute to this disparity (2002). They initially based this theory on research suggesting that women in leadership roles are seen as less capable than men as people tend to undervalue women's leadership skills relative to those of men in comparable positions (2002).

When Eagly and Karau initially coined role congruity theory in 2002, they primarily focused on leadership roles in the workplace; however, current research has expanded to cover people in diverse positions and careers. The overall support for this approach lies in evidence that when a person's gender is incongruous with gender role expectations, others may view them as less capable of success (Clow, Ricciardelli, & Bartfay, 2015). In other words, in jobs associated with masculinity, people tend to view women as less capable than men, possibly increasing hostile sexism against women. For instance, Simon, Wagner, and Killion found that women in STEM academic careers experienced more difficulties with gender bias, especially if they were more stereotypically feminine (2017). Likewise, men in feminine jobs may face similar bias. For example, people, especially men, view male nurses more negatively than female nurses (Clow, Ricciardelli, & Bartfay, 2015). Specifically, patients are less likely to want to meet them, their fathers often disapprove of their career, and people see them as "failed doctors." Furthermore, male nurses are often disallowed from entering gynecology areas that female nurses and male doctors are permitted in (Clow, Ricciardelli, & Bartfay, 2015). In fact, male nurses were often assigned to more masculine-associated tasks, such as physical labor. While the researchers did not find that people viewed nursing as an inappropriate career for men overall,

participants viewed male nurses described in very masculine terms as less competent than male nurses described with neutral language. Based on these results, Clow, Ricciardelli, and Bartifay concluded that men are not only seen as less capable in nursing because of gender role incongruity, emphasizing the incongruity with masculine language increased this bias.

Garcia-Retamero and López-Zafra found similar evidence for role congruity theory in a 2006 study comparing male and female candidates for a promotion. Participants predicted that female candidates were more likely to be promoted than male candidates in a more feminine industry, whereas men were more likely to be promoted in a masculine industry. While participants saw no difference in how realistic a promotion would be for men or women in a feminine industry, they saw men as having a more realistic chance at a promotion than women in a masculine industry (Garcia-Retamero, & López-Zafra, 2006). Overall, the more gendered the expectations for an industry, the greater the difference in predicted promotion for male and female candidates. As discussed by Heybach and Pickup (2017), the higher proportion of men in STEM is not necessarily the cause of fewer women entering STEM, just a symptom of the gender bias problem. Therefore, this research supports the role congruity theory as an explanation for gender bias in the workplace.

Further research provides possible explanations for role congruity theory. In particular, gender stereotypes play a major role, especially when gender stereotypes are subverted. For instance, more conventionally attractive, feminine women are seen as less likely to be seen as scientists and more likely to be seen as teachers compared to less feminine women (Banchefsky, Westfall, Park, & Judd, 2016). Historically, even children have held stereotypes about women in STEM: in 1983, they tended to draw a man when asked to draw a scientist (Heybach & Pickup,

2017). One explanation offered for this phenomenon is unconscious or conscious reinforcement by parents and educators: many desirable characteristics designated as feminine do not align with the role expectations for STEM careers (Heybach & Pickup, 2017). According to a 2017 study, students viewed STEM courses as more for boys than for girls (Blažev, Karabegovic, Burušic, & Selimbegovic, 2017). These stereotypes were strongest when students did well in STEM, regardless of gender, potentially indicating that at some point in their STEM experience these expectations were reinforced. Researchers suggest that this stereotype incongruence may negatively impact girls' actual STEM performance, creating a sort of self-fulfilling prophecy (Heybach & Pickup, 2017). Additionally, gender stereotypes may impact students' interest in STEM: boys with the stereotype that STEM is more masculine were more interested in STEM, while girls with this stereotype were less interested (Blažev, Karabegovic, Burušic, & Selimbegovic, 2017).

The stereotypes involved in the role congruity explanation for gender bias generally fall into two categories: descriptive and prescriptive. As shown in a study by Bobbitt-Zeher, 38% of women involved in gender discrimination cases analyzed from 1988-2003 cited descriptive stereotypes in their complaints (2011). These descriptive stereotypes included assumptions that women are too hormonal, unintelligent, or emotional to handle certain jobs. The researchers discussed a pattern that many of these women were seen as women before they were seen as workers, and thus incompatible with masculine jobs. In addition, some women mentioned prescriptive stereotypes, involving expectations for how women should and should not act. For example, women were expected to behave in a "ladylike" manner and avoid becoming pregnant

(Bobbitt-Zeher, 2011). Overall, a variety of negative prescriptive and descriptive stereotypes may shape the expectations involved in the role congruity theory explanation for gender bias.

Finally, it is important to note that an individual's gender may be a greater factor in the role congruity theory of gender bias than the gender connotations of their personality or behavior. In particular, research by Simon, Wagner, and Killion indicates that while women in STEM courses were at a disadvantage compared to men in STEM courses, feminine women face the greatest bias through hostile behavior and less social support (2017). In contrast, feminine men were actually more likely to have positive experiences, social support, and to continue to pursue STEM study (2017). In other words, men in the more masculine-coded STEM subjects were less likely to face gender-based bias and obstacles than women, even if they had feminine traits. In fact, men actually benefited from exhibiting feminine characteristics that women were penalized for. Women were at the greatest disadvantage in STEM academia even when they had more masculine characteristics (2017). These results indicate that role incongruity has the greatest effect on gender bias when the incongruity is between a person's gender and their field rather than their personality.

Sociocultural Differences in Bias

Interestingly, the degree of impact from gender bias and role congruity on perception may vary depending on the sociocultural factors through which people evaluate a professional. Research by Hollup revealed that gender bias in nursing in the island nation of Mauritius differed from that in other countries (2014). According to this research, differential treatment based on gender did exist in this region; however, this treatment tended to correspond with

general societal gender bias against women rather than gender bias specifically against nursing professionals. In fact, the Mauritians tended to see the nursing role as inherently gender-neutral. The researchers speculated that this perception may be due to the Mauritian nursing field historically being composed of approximately equal numbers of male and female professionals. In other words, role congruity theory may apply to the same occupation differently depending on sociocultural influences. In Clow's, Ricciardelli's, and Bartifay's study, people in Canada tended to see male nurses as less competent and assigned them different roles because they perceived nursing as a feminine-gendered career (2015). In contrast, Hollup found that people in Mauritius did not see male or female nurses differently because they did not perceive nursing as a particularly masculine or feminine career; rather, any gender bias tended to be at the expense of female professionals because of their gender rather than an interaction between their gender and the gendered connotations of their career (2014). With this in mind, it is evident that research on gender bias in one region cannot be generalized to all society without considering potential sociocultural differences among nations.

Gender Differences in Bias

Another factor in workplace gender bias, including issues in STEM, is that people of different genders may have different levels of bias. For instance, in Moss-Racusin, Molenda, and Cramer's study involving STEM gender bias research posted on the social media platform Facebook, men posted the majority of negative comments (2015). These included sexist comments and remarks disagreeing with the evidence supporting the existence of STEM gender bias. Furthermore, Latu and colleagues found that male participants implicitly associated men

with success than women (2011). Likewise, female participants implicitly associated women with success more than men, although the effect was smaller. These findings indicate that male participants may be more likely to exhibit gender bias in favor of other men, perhaps because they share the same in-group. Such in-group bias was echoed in Abel and Meltzer's research: female participants had more positive attitudes towards women compared to male participants, according to their sexism scores (2007).

Another explanation for men exhibiting higher gender bias against women is zero-sum thinking. According to Kuchynka and colleagues, gender-based zero-sum thinking occurs when men assume that when women gain success, men lose success (2018). This phenomenon coincides with the aforementioned in-group bias because it involves men perceiving women as an out-group in competition with their in-group. In one study examined by Kuchynka and colleagues, men tended to be less likely to support reductions in gender bias when they felt their masculinity or success was threatened by these measures; however, women did not exhibit this same behavior when presented with a similar situation. In other words, men who see their success as inversely related to women's success in line with zero-sum thinking are more likely to reinforce gender bias in the workplace (2018). With this in mind, zero-sum defensive thinking in combination with in-group mindset may contribute to greater workplace gender bias in men against women.

Contrary to these in-group versus out-group explanations for gender bias, researchers have identified cases where men exhibit gender bias against other men in the workplace. In Clow's, Ricciardelli's, and Bartfay's research on perceptions of male nurses, male participants often viewed male nurses as less competent and more deviant than female nurses, particularly

when participants had higher hostile sexism scores; however, they also ranked nurses as being more competent overall than female participants (2015). While these findings may seem to conflict with the in-group bias approach, another factor may have affected these results: male nurses serve a role that is incongruous with gender expectations. Interestingly, male participants may estimate the effect of role incongruity as being less than female participants: research by Garcia-Retamero and López-Zafra showed that male participants predicted that a woman was more likely to be promoted than female participants expected (2006). Overall, the research suggests that participants, especially those with more traditional beliefs about gender roles, tend to exhibit a bias in favor of like-gendered professionals, unless they are breaking gender expectations.

Although there is evidence supporting gender differences in which people are more likely to exhibit gender bias, there is also evidence that individual personal factors may also play a role. For instance, Abel and Meltzer found that men with more traditional values and women with more liberal values saw a female professor as more sexist compared to participants of other backgrounds (2007). As some female participants exhibiting bias against the female professor contradicts the previously discussed in-group bias findings, this study suggests that participant background can also impact their perspectives and gender bias. Regardless of participant gender, higher hostile sexism scores are associated with implicit expectations for men to be more successful compared to women in the workplace (Latu, et al., 2011). As hostile sexism scores may be impacted by a person's background including conservative or liberal ideology leanings, these factors may also impact degrees of gender bias. Interestingly, these researchers also found that participants who scored as having high drive to please others also tended to display less

gender bias against women (2011). Overall, these results indicate that individual factors such as a person's personality, background and values may affect their level of gender bias in addition to or even regardless of their own gender.

Denial of Gender Bias

Although there is ample evidence for gender bias in STEM fields and academia, many people deny the existence of any such issue. This problem persists even when the information is presented in an accessible manner, as shown by Moss-Racusin, Molenda, and Cramer in 2015. The researchers shared an article discussing evidence for STEM gender bias on science-oriented Facebook pages and analyzed the commented responses. While the majority of comments were positive, 17% were sexist, 22% attempted to justify STEM gender bias, and 24% explicitly disagreed with the evidence. Although the articles appeared on science-oriented pages, the researchers found no significant difference between the responses of people associated with STEM and the general public. Based on these findings, a major obstacle to combating STEM gender bias may be denial even when presented with supporting research.

Implications of Gender Bias

Given the evidence supporting the existence of workplace gender bias, it is important to understand the implications of said bias in STEM and other fields. Analysis by Bobbitt-Zeher indicates that gender bias may manifest in discriminatory workplace policy, particularly in cases of sexual harassment, unequal resources and working conditions, and unjust termination of female professionals (2011). In this study, 84% of reported discrimination cases involved policy

issues: either biased policies that were only applied when they benefitted male employees or the absence of policies handling sexual harassment and gender discrimination.

In STEM, gender bias may be responsible for what Heybach and Pickup deemed a "leaky pipeline," in which qualified female professionals are more likely to leave STEM than their male colleagues, especially at higher-ranked career levels (2017). A likely explanation, according to Moss-Racusin and colleagues, is that women feel less belonging, had fewer aspirations, and anticipated more discriminatory treatment than men in a gender-biased environment, while there is no difference in the absence of gender bias (2018b). Therefore, the gender bias revealed in the aforementioned STEM research may decrease women's likelihood to remain in STEM academia and careers. As a result, employers may not be hiring the best candidates, influenced by conscious or subconscious gender bias rather than only considering candidates' qualifications (Heybach & Pickup, 2017).

STEM gender bias may also negatively impact men who violate role congruity theory. While STEM as a whole tends to be more male-dominated, the nursing field carries feminine gender connotations with only 15% of nursing students being men (Powers et al., 2018). Therefore, men in nursing careers violate role congruity by entering a feminine occupation. Based on this role incongruity, nursing instructors treat male students more negatively: accusing them of using nursing as a step to a different career and having a poor work ethic in comparison to female colleagues (Powers et al., 2018). In particular, the researchers noted that male nursing students did not feel they received the same opportunities as female nursing students, instead designated to perform more masculine-assigned tasks. As discussed by Smeding's 2012 study, STEM gender bias can negatively impact female student performance in STEM courses;

similarly, Powers and colleagues mention that male nursing students may perform worse and be more likely to change careers than female nursing students (2018). Just as STEM careers in general are at risk of becoming leaky pipelines with fewer and women continuing in STEM careers over time than men, nursing may show a similar trend with male students leaving if gender bias against them continues.

Another concerning implication of STEM gender bias and the resulting gender gap is that STEM research may be limited. As there may be some degree of bias in research interpretation depending on the researchers involved, having a majority-male perspective may limit the progress of STEM investigations. Fewer women in STEM means that fewer STEM researchers are female, potentially limiting how information is collected and interpreted without more diverse viewpoints involved. As Heybach and Pickup described this phenomenon, STEM research could be influenced by onto-epistemologies; in other words, a person's identity and perspective impacts how they understand the world (2017).

Future Solutions

Considering the implications of gender bias in STEM, there is a need for effective solutions for this issue. Moss-Racusin and colleagues developed and evaluated the success of several different approaches (2018a). First, the researchers created a board game called WAGES that was geared towards raising STEM gender bias awareness and education. Next, they created VIDS, videos for students based on gender bias research that were published for free online to make them accessible to the general public. These included evidence-based plays and interviews with experts on the subject. Of the two methods, the expert interviews were most successful in

increasing logical thinking; however, both VIDS significantly increased viewers' awareness of STEM gender bias, positive attitudes towards women in STEM, and their empathy and anger response to the issue compared to a control group (Moss-Racusin et al., 2018a). In VIDS involving an expert interview, the researchers found that viewers had significantly lowered gender bias (Moss-Racusin et al., 2018a). Because these results were consistent for both male and female students, these tools may be effective in reducing gender bias in the student population if integrated into curriculums on a larger scale.

Another strategy for reducing STEM-related gender bias is to distribute research via social media. Moss-Racusin, Molenda, and Cramer found that, when research was distributed via Facebook page articles, 78% of commenters agreed with the results, 13% discussed possible solutions, and the majority of responses were positive (2015). Furthermore, there was no difference in responses between commenters associated with STEM fields and the general public, suggesting that the information was equally effective regardless of STEM involvement (Moss-Racusin, Molenda, & Cramer, 2015). Like the VIDS approach, this method allows the general public free access to supporting evidence; however, there is the potential to reach a wider audience as social media is used by people from a variety of backgrounds while VIDS focused on students.

While research supports the effectiveness of educational materials about STEM gender bias, there is also evidence that exposure to STEM in early education has the potential to reduce the STEM gender gap. Research by Hübner and colleagues compared student interest in mathematics and STEM as well as STEM course performance before and after German high schools made advanced mathematics courses mandatory (2017). The results showed that, after

the curriculum change, female students spent more time on mathematics, performed better in class, and had a more positive self-view, while male students' time commitment increased by a smaller amount and their performance remained the same so that the gender gap narrowed. Furthermore, all students exhibited an increased interest in STEM, particularly for male students, as well as better performance in later STEM courses. While the researchers were unable to conclude whether the curriculum change affected students' likelihood to actually enter STEM careers, these findings indicate that increased higher-level STEM exposure in early education may increase overall interest and success in STEM subjects.

Additional support for the success of STEM exposure in early education can be found in research on recreational school activities. Levine and DiScenza compared highschool student views about STEM before and after a one-day, eight-hour interactive program (2018). During the program, students participated in candy-themed educational experiments, such as learning about chromatography by separating dissolved candy by color. In both 2016 and 2017, pre-and post-program survey comparisons revealed more positive views of science and higher perceived value of science after students completed the program (Levine & DiScenza, 2018). In this way, hands-on STEM exposure in early education, even for a relatively brief period of time, may help improve student's interest in STEM and thus potentially increase the likelihood that girls would later consider STEM careers. Because this was not a longitudinal study, there is a need for more research to conclude whether these benefits last beyond the completion of the program and determine whether such activities should be hosted at more schools.

To combat gender bias within STEM workplaces and academia, researchers have investigated applications of positive psychology. Casad and colleagues found that boosting

women's confidence in their competence, giving them a shared goal, instilling the value of unity in STEM, reinforcing a sense of belonging, and providing positive role models may encourage more women to pursue STEM careers (2018). In fact, Heybach and Pickup emphasized the long-term importance of positive female role models in increasing STEM retention of female professionals (2017); however, not all of the results supported this claim. Heybach and Pickup also found research that suggests that female role models may actually decrease STEM interest in young girls because of the aforementioned gender role incongruity (2017). Therefore, while this solution may be beneficial when applied to women within STEM fields, it may not produce the same effect when applied to younger girls.

Perhaps the solution lies not in emphasizing women's belonging in STEM, but in deemphasizing women as any different from men in STEM. Further investigation by Heybach and Pickup suggested that part of the problem with the current approach to making women feel valued in STEM is that it emphasizes the breach in gender roles by "painting STEM pink," thus decreasing positive perception in line with role congruity theory (2017). Alternatively, the researchers recommend degendering STEM by recognizing how gender differences may have affected STEM development and working to remove the masculine connotation of science fields. While this approach needs research to support or refute its efficacy, the researchers hold degendering STEM would be a sort of self-fulfilling prophecy: if more women enter STEM because there is less emphasis on gender, then people would be hired based on their skill set rather than gender-based factors, increasing the overall gender equality in STEM fields. This positive effect of degendering STEM may also benefit men: in research by Powers and colleagues, male nursing students specifically mentioned that they would be more comfortable in

the nursing field if people treated the occupation as more gender-neutral (2018). Therefore, the gender-neutral approach to STEM may not only alleviate the more common gender bias against women in STEM, but also improve the experiences of men in currently feminine-assigned STEM careers.

Current Research

While there is limited research on how people perceive a professional differently based on both gender and occupation, the research reviewed indicates that there may be a relationship between these factors and bias. Certain professions are implicitly labeled as being masculine (e.g., engineer) or feminine (e.g., school teacher) (White & White, 2006). Gender discrimination including hiring and harassment has been shown to be more prevalent in male-dominated than female-dominated workplaces (Bobbitt-Zeher, 2011). This difference may be related to gender expectations: women who break gender norms in the workplace are at a greater risk of experiencing prejudice (Garcia-Retamero & López-Zafra, 2006). This explanation coincides with the role congruity theory of gender bias.

The general purpose of this study is to identify bias against a professional based on their career field and gender and investigate whether there is an interaction between the two variables. For the purpose of this experiment, masculine pronouns indicate a male professional and feminine pronouns indicate a female professional. In addition, this study analyzes whether participant scores on a sexism scale relate to how they view professionals differently. Overall, the researchers anticipate that participants will be biased against professionals based on their gender and career, with significantly more bias against women and the “feminine” school

teaching career and an interaction between these variables significantly increasing bias when gender and career were incongruous. Likewise, the researchers expect a positive correlation between Ambivalent Sexism Inventory scores and participant gender bias overall.

Hypothesis 1: Main Effect of Gender on Perception.

Based on the literature discussed, the researchers hypothesize that participants will exhibit more negative perceptions of female professionals compared to male professionals.

Hypothesis 2: Main Effect of Occupation on Perception

Furthermore, participants are predicted to have more negative perceptions of the non-STEM schoolteacher versus the STEM medical doctor.

Hypothesis 3: Interaction Between Gender and Occupation

Finally, the researchers expect participants to have the most negative perceptions of the female doctor doctor because of incongruity between a STEM career and the stereotypical female gender role. Participants will have comparatively more positive perceptions of the female school teacher as there is no gender role incongruity; however, previous research suggests bias against women occurs in the workplace regardless of career. Likewise, the researchers expect the most positive perceptions of male doctors as there is no gender role incongruity and previous findings suggest that there is a societal bias in favor of men in the workplace. Participants are also predicted to view the male school teacher more positively because, despite male gender role

incongruity, previously analyzed research indicates an overall societal preference for men in the workforce.

Methods

For this thesis investigation, the researchers used an online survey method with Likert scale questions similar to those used by Abel & Meltzer in 2007 and Garcia-Retamero and López-Zafra in 2006. A total of 290 undergraduate psychology students from Florida Southern College served as participants in exchange for extra credit towards their courses. Most of these students were sampled from the SONA psychology research pool. Underage (under 18 years old) participants were identified at the beginning of the online survey and redirected to a page with contact information for the researcher. Upon contacting the researchers and having their parents or guardians complete the provided Parental Consent Waiver Form, they were allowed to participate and take the survey. Participation generally took no longer than 10 minutes.

The researchers used a 2 (Occupational Field: STEM, Non-STEM) x 2 (Gender: female, male) between-participant design. They used random assignment so that participants were equally likely to be assigned either condition. There were four vignette conditions: male/STEM, female/STEM, male/non-STEM, and female/non-STEM. For the purposes of this study, the professional in the STEM occupation was a medical doctor, and the professional in the non-STEM occupation was a school teacher. The dependent variables of interest were the bias score based on questionnaire responses assessing how positively or negatively participants view the professional in their given vignette and sexism scores on the Ambivalent Sexism Inventory (Glick and Fiske, 1996). Potential grouping variables for future analysis such as participant gender and undergraduate major were included in the collected demographic information.

Once a participant signed up for the study via SONA, they were provided with a link to the online study materials in a survey format. They were asked their age, and if they were under

18 they were redirected as mentioned previously and their parent or guardian completed a parental consent waiver form before they could participate (refer to Appendix A). Participants who were 18 or older were directed to an informed consent waiver to confirm willingness to take part in the study (refer to Appendix B). The online survey randomly assigned the participant to one of the four vignette conditions in which the professional was either male or female and either in a STEM occupation (medical doctor) or non-STEM occupation (school teacher) (refer to Appendix C and D). The participant then answered questions about the person in the vignette using a Likert scale (refer to Appendix E). After completing this portion of the survey, the participant completed the Ambivalent Sexism Inventory used with permission from Glick and Fiske (1996) (refer to Appendix F). After the participant completed the ASI and demographics questionnaire (refer to Appendix G), they were debriefed (refer to Appendix H), thanked for their participation, asked not to disclose details of the study with others, and the survey ended.

Results

The researchers analyzed the data with a general linear model (refer to Appendix I). The data do not support Hypothesis 1: there was not a main effect of gender on perception of the professional (Male $M = 3.921$; $SD = 0.048$, Female $M = 3.942$; $SD = 0.049$). The data also did not support Hypothesis 2: there was not a main effect of occupation on perception of the professional (STEM $M = 3.976$; $SD = 0.047$, Non-STEM $M = 3.888$; $SD = 0.049$). Finally, the data did not support Hypothesis 3: there was no interaction between gender and occupation on perception of the professional. To examine internal consistency, the researchers calculated a Cronbach's Alpha of 0.892. Because 74% of participants were female, there were too few male participants to evaluate participant sex differences in ASI scores.

Discussion

These data do not support the hypotheses. In other words, there were no significant differences in how participants viewed a professional based on gender, occupation, or an interaction between these two variables. As shown in Figure 1, participants did not view male and female professionals significantly differently, suggesting that gender bias did not influence perception (refer to Appendix I). Additionally, participants did not view the schoolteacher and the medical doctor significantly differently. This finding indicates that bias surrounding occupation type (STEM vs. non-STEM) did not affect how participants evaluated each professional. Furthermore, Figure 1 demonstrates no significant interaction between a professional's gender and occupation type. Thus, participants did not exhibit bias in line with role congruity theory: evaluations remained consistent for both male and female professionals regardless of their occupation. Although all participants did complete ASI questionnaires, there was too great a disparity between the number of male and female participants to compare their scores (Male N=74; Female N=215; Non-Binary N=1).

These results contradict previous research findings that support the existence of gender bias. For instance, the data did not support the hypothesis that participants would view female professionals more negatively than males in an identical occupation. Previous research indicates that people tend to see female professionals as less competent than their male colleagues even before they are hired and that female candidates are less likely to be hired compared to male candidates for laboratory positions (Bobbitt-Zeher, 2011; Moss-Racusin et al., 2018a). In contrast, the current study not only found no significant preference for male over female professionals, it also revealed no significant differences in how often participants saw the

professionals as competent based on their gender. While the current study did not ask participants whether or not they would hire the professional, the current findings also contradict research involving female and male professionals after the hiring stage. Abel and Meltzer and Bobbitt-Zeher found that female professionals are more likely to be treated negatively compared to male professionals in the same career (2007; 2011). Therefore, the results of the current study call these findings into question and suggest that either attitudes have shifted in the direction of less gender bias or the current study did not accurately reflect overall gender bias attitudes.

In addition to contradicting research on gender bias, these findings contradict research on role congruity theory. The general trend in research has supported the existence of an interaction between gender bias and occupation. Specifically, female professionals face more gender discrimination in workplaces that people see as more masculine (Bobbitt-Zeher, 2011). STEM jobs tend to be coded as more masculine according to research by White and White (2006). It follows that participants would likely view a female professional in a masculine-coded STEM career, as described in one of the vignettes in the current study, with more negative biases than a female professional in a feminine job or a male professional in a masculine job. Even so, the current study found no such interaction between the professional's gender and career on how participants viewed them. This finding is contrary to the aforementioned research and role congruity theory, which holds that a professional whose gender does not match the gendered connotations of their career would be subject to more negative perception by participants.

One major explanation for the disparity between the current study's results and the results of previous research is the choice of STEM and non-STEM representative occupations. The researchers chose to designate a schoolteacher as the representative non-STEM career and a

medical doctor as the representative of a STEM career based on their own schemas of non-STEM and STEM occupations. In retrospect, the researchers identified a problem with using a schoolteacher as a representative of non-STEM occupations: participants may have associated schoolteachers as much with STEM careers as non-STEM careers because many teachers specialize in STEM subjects. Although teaching in and of itself is not a STEM occupation, the researchers did not mention a specific teaching subject; In other words, the current study did not account for the impact of STEM school subjects on whether a schoolteacher fit with participant schemas for non-STEM careers. With this in mind, the absence of a relationship between the vignette professional's gender and the STEM or non-STEM label for their career may result from high ambiguity surrounding whether a schoolteacher is a STEM or non-STEM professional.

Despite contradictions with previous research on gender bias and role congruity theory, the current study did have high levels of reliability as indicated by internal consistency. This claim is supported by a Cronbach's Alpha of 0.892. Ideally, Cronbach's alpha should be 0.70 or greater to indicate that the results are sufficiently reliable ("What does Cronbach's Alpha mean?"). Thus, this measurement of internal consistency confirms that the results of this study are reliable. In other words, participants likely did not pick random responses to rush through the survey.

While these findings are promising in that they are reliable and reflect decreased gender and occupation biases compared to previous research, this discrepancy may not necessarily be reflective of reality. Specifically, participant demographics may limit how well these results can be generalized to the overall population. Participant age range, ethnic background, and nationality were relatively homogenous: 74% were female, 85% were caucasian/white, and 92%

were from the United States. Therefore, this sample's experiences and biases may not necessarily coincide with those of the general population; rather, they only represent the college population.

In light of the aforementioned sampling issues, future research should aim to better represent societal biases. To this end, the researchers propose extending the study reach by opening up the survey to people online. This approach would allow for more diverse responses as it would reach a greater variety of people; however, it is not free from sampling issues. Researchers must be mindful of what avenues they use to distribute the study. Rather than risk sampling bias by distributing the study on their own, they should use a survey resource with random sampling from a large potential participant pool. Because this approach would likely involve avenues of data collecting that offer some financial incentive to participants, additional measures would be important to maintain result integrity. Potential quality control measures include questions that explicitly tell participants to select a certain response (i.e., a color or a number) to test whether participants read all questions thoroughly. The primary concern with this method is that even attentive participants may rush through questions instead of answering honestly. To account for this problem, future researchers may include time measurements so that participants who answer too quickly are eliminated from the study. With appropriate measures for maintaining response quality combined with Cronbach's Alpha for internal reliability, a broad-reaching online study may gather a more representative sample of the general population.

Another methodological alteration that may achieve more accurate results would be to choose more representative STEM and non-STEM careers. As previously mentioned, the results of the current study may not be representative of how participants view professionals in STEM versus non-STEM careers because the chosen occupations may not fit participant schemas for

STEM and non-STEM jobs. One approach to this problem would be to explicitly state that the professional is in a STEM or non-STEM career. While this could potentially be added to the vignette, there is a risk that it will alert participants to the intention of the research and lead to demand characteristics that skew the data. A better solution would be to create a survey where participants rank individual careers as more representative of STEM or non-STEM occupations on a Likert scale. Using this survey, future researchers could identify which careers their sample pool most associated with their STEM and non-STEM schemas. This survey would be conducted some time before the actual study to reduce the chance that participants will link this preliminary research with the main study. With this strategy, future researchers could ensure that their research includes more appropriate careers and draw more definitive conclusions based on their data.

Future research should not only address limitations of this study, but also explore new directions. For example, this research defined "gender" through "he" or "she" pronouns and assumed that participant sex and gender identity were consistent with one another. These assumptions limited the study scope to rather narrow definitions of gender. Moving forward, researchers could add a condition with the neutral "they" pronoun and account for participants who self-describe as "agender" or "nonbinary." This research would provide insight into whether the presence or absence of gendered pronouns could affect participant perceptions. Additionally, researchers could identify whether agender or nonbinary participants exhibit different biases compared to men or women participating in the study. Combining this broader scope with the aforementioned wider distribution of the study may allow for enough responses to draw conclusions about participants with less common gender identities.

Conclusion

Overall, the results did not support the hypotheses; however, they suggest that gender and STEM occupation bias may be lower than previously reported. In summary, participants showed no perception differences based on a professional's gender or occupation. While these results are encouraging as they do not support the existence of these biases, it is important to consider other factors that may have influenced data. Thus, additional research is needed in this area, especially involving larger samples that better reflect the overall population. Should these results be supported by further studies, they would indicate that current bias-reduction approaches have been relatively successful. Even so, based on numerous previous studies supporting the persistence of gender and occupation biases, there would still be a need for further research into particularly affected populations. For instance, STEM workplaces may have different bias levels than non-STEM workplaces or the general population. With these issues in mind, the results of this study should not be considered conclusive on their own; rather, they should be understood in the context of other research to better understand gender and occupation bias.

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Appendices

Appendix A
Parental Consent Waiver Form

I am the parent/guardian of _____ [student's name] and I understand that my child is currently enrolled in PSY 1106/PSY 1110, and that he/she is expected to learn about research in psychology by participating in a series of empirical studies. Studies typically involve computer tasks, completion of surveys, response to audio or video presentations, completion of standardized tests, etc. They are approved by the College's Institutional Review Board and there will be no disclosure of individual performance. Each of these studies is required to provide my child with a Consent Form prior to their participating. However, since my child is not yet 18, he/she does not have the legal status to consent to participate. I understand that my child may refuse to participate in any study to which s/he has any objection.

I therefore [check one]:

_____ Delegate authority to my child to sign individual Informed Consent forms for empirical studies associated with courses in the Department of Psychology.

_____ Retain authority to sign individual Consent Forms for any study in which my child participates.

_____ Do not want my child to participate in any studies, and therefore would like him/her to be assigned an alternative activity.

_____
Signature

_____
Printed Name

_____
Relationship to Student

_____
Date

Appendix B

Informed Consent

Information to Consider Before Taking Part in this Research Study

Project Title: Perceptions of Occupations

Investigators: Dr. Charlie Law, Jordan King

PURPOSE OF THE STUDY: You are being asked to participate in this study to further research on occupation perceptions.

STUDY PROCEDURES: If you agree to participate in this study, you will be asked to complete a survey via computer. The study should take no longer than 30 minutes.

RISKS AND DISCOMFORTS: There are no more risks than those involved in everyday activities.

POTENTIAL BENEFITS: You will not directly benefit from participating in this study, however the results may help researchers better understand how people view occupations. Some participants may receive course credit if allowed by his/her professor.

CONSENT: By signing this consent form, you are agreeing that you both understand and accept the procedures of this study in addition to any possible risks and/or benefits incurred as a result of participation.

CONFIDENTIALITY: We must and will keep your study records confidential. Your privacy will be protected because you will not be identified by name as a participant in this project. Your data will be assigned a number code and will be kept in a locked cabinet. No records will be kept with your name on them. The obtained information will be kept until the data collection is complete and will be shredded after completion. However, certain people may need to see your study records (including IRB officials). By law, anyone who looks at your records must keep them completely confidential.

VOLUNTARY PARTICIPATION/WITHDRAWAL: Your participation is completely voluntary and you are free to refuse to participate or to withdraw your consent to participate in this research at any time without penalty or prejudice.

QUESTIONS, CONCERNS, OR COMPLAINTS: If you have any questions, concerns, or complaints, please contact the Chair of the Institutional Review Board at (863) 680-6205, the VP for Academic Affairs at (863) 680-4124, Jordan King at (407) 451-9724, or Dr. Law at (570) 516-6078.

Consent to Take Part in this Research Study

It is your choice whether or not you want to take part in this study. If you would like to take part and the following statements are true, please sign this form.

I freely and voluntarily give my consent to take part in this study. I understand that by signing this form I am agreeing to take part in research. I agree not to disclose to anyone details about the workings of this study until after its completion.

_____ _____

Signature of Participant Date

_____

Printed Name of Participant

Appendix C

Vignette: STEM

Note: The gender pronouns will vary between conditions

A medical doctor begins **his/her** work early in the morning. **His/Her** day starts with a cup of coffee as **he/she** arrives at the hospital and reviews the day's schedule in **his/her** office. **He/she** then prepares for the first appointment of the day. When **his/her** patient arrives, **he/she** greets them and proceeds with a routine checkup but notices signs of a serious undiagnosed medical condition. As **he/she** is unsure whether **he/she** should diagnose the condition or refer the patient to a specialist, **he/she** organizes a meeting with **his/her** colleagues to discuss the issue.

Following the input of **his/her** colleagues, the doctor decides to go over the symptoms **he/she** observed with **his/her** patient directly, but refrain from reaching a diagnosis until the patient's condition has been assessed by a specialist.

Appendix D

Vignette: Non-STEM

Note: The gender pronouns will vary between conditions

A schoolteacher begins **his/her** work early in the morning. **His/Her** day starts with a cup of coffee as **he/she** arrives at the school and reviews the day's schedule in **his/her** classroom. When **his/her** students arrive, **he/she** greets them and proceeds with a routine lesson but notices signs that many students are not understanding the material. As **he/she** is unsure whether **he/she** should have a review day in class or refer students to peer mentors, **he/she** organizes a meeting with **his/her** colleagues to discuss the issue.

Following the input of **his/her** colleagues, the teacher decides to go over the problems **he/she** observed with **his/her** class directly, but refrain from dedicating an entire day to review until the students study with a peer mentor.

Appendix E

Vignette Questionnaire

For items 1 - 10 please circle the answer that best fits your view regarding the person in the vignette.

1. I would be willing to hire this person.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

2. This person behaves professionally.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

3. This person is a poor leader.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

4. This person is knowledgeable.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

5. This person is bad at their job.

1	2	3	4	5

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

6. This person is naive.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

7. This person is productive.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

8. I believe this person's approach will be successful.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

9. This person is unoriginal.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

10. This person is incompetent.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Appendix F

The Ambivalent Sexism Inventory (ASI)

Note: Used with permission of the authors.

Relationships Between Men and Women

Below is a series of statements concerning men and women and their relationships in contemporary society. Please indicate the degree to which you agree or disagree with each statement using the following scale: 0 = disagree strongly; 1 = disagree somewhat; 2 = disagree slightly; 3 = agree slightly; 4 = agree somewhat; 5 = agree strongly.

___ 1. No matter how accomplished he is, a man is not truly complete as a person unless he has the love of a
woman.
___ 2. Many women are actually seeking special favors, such as hiring policies that favor them over men, under
the guise of asking for "equality."
___ 3. In a disaster, women ought not necessarily to be rescued before men.
___ 4. Most women interpret innocent remarks or acts as being sexist.
___ 5. Women are too easily offended.
___ 6. People are often truly happy in life without being romantically involved with a member of the other sex.
___ 7. Feminists are not seeking for women to have more power than men.
___ 8. Many women have a quality of purity that few men possess.
___ 9. Women should be cherished and protected by men.
___ 10. Most women fail to appreciate fully all that men do for them.
___ 11. Women seek to gain power by getting control over men.
___ 12. Every man ought to have a woman whom he adores.
___ 13. Men are complete without women.
___ 14. Women exaggerate problems they have at work.
___ 15. Once a woman gets a man to commit to her, she usually tries to put him on a tight leash.
___ 16. When women lose to men in a fair competition, they typically complain about being discriminated
against.
___ 17. A good woman should be set on a pedestal by her man.
___ 18. There are actually very few women who get a kick out of teasing men by seeming sexually available
and then refusing male advances.
___ 19. Women, compared to men, tend to have a superior moral sensibility.
___ 20. Men should be willing to sacrifice their own well being in order to provide financially for women in
their lives.
___ 21. Feminists are making entirely reasonable demands of men.

___ 22. Women, as compared to men, tend to have a more refined sense of culture and good taste.

Appendix G

Demographics Questionnaire

Age _____

College year _____

Major _____

Gender _____

Race/Ethnicity _____

Deceased Parent Yes No

If yes, which parent? _____

What is your country of origin? _____

If outside of the U.S., which country have you lived in the longest? _____

Which state did you live in most of your life? _____

Who was your primary caretaker? _____

Appendix H

Debriefing Form

Thank you for taking part in my study! I appreciate your patience and participation. I will now explain the experiment in detail. You were first randomly assigned to one of four conditions with a vignette featuring either a male or female STEM or non-STEM professional, followed by a questionnaire measuring how positively or negatively you perceived them. You then took the Ambivalent Sexism Inventory, which measures attitudes towards women. Following this portion of the study you then filled out a demographics form. The real purpose of this experiment is to investigate how individuals would perceive a professional positively or negatively depending on the professional's gender and/or career field. I believe participants are more likely to view men in STEM careers the most positively whereas women in STEM careers will be seen the most negatively. I had to withhold the true purpose of the experiment so as not cause any issues regarding the results of future participants. I ask that you please refrain from discussing this experiment with anyone because if participants know ahead of time what this study is examining I would be unable to use their data and my results could be skewed.

_____

_____

Participant Signature

Date

Appendix I

Figure 1. Effects of Gender and Occupation on Perception of a Professional