Sex Roles
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ORIGINAL ARTICLE

How Gender and Race Stereotypes Impact the Advancement of Scholars in STEM: Professors' Biased Evaluations of Physics and Biology Post-Doctoral Candidates

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Abstract

The current study examines how intersecting stereotypes about gender and race influence faculty perceptions of post-doctoral candidates in STEM fields in the United States. Using a fully-crossed, between-subjects experimental design, biology and physics professors ($n = 251$) from eight large, public, U.S. research universities were asked to read one of eight identical curriculum vitae (CVs) depicting a hypothetical doctoral graduate applying for a post-doctoral position in their field, and rate them for competence, hireability, and likeability. The candidate's name on the CV was used to manipulate race (Asian, Black, Latinx, and White) and gender (female or male), with all other aspects of the CV held constant across conditions. Faculty in physics exhibited a gender bias favoring the male candidates as more competent and more hirable than the otherwise identical female candidates. Further, physics faculty rated Asian and White candidates as more competent and hirable than Black and Latinx candidates, while those in biology rated Asian candidates as more competent and hirable than Black candidates, and as more hireable than Latinx candidates. An interaction between candidate gender and race emerged for those in physics, whereby Black women and Latinx women and men candidates were rated the lowest in hireability compared to all others. Women were rated more likeable than men candidates across departments. Our results highlight how understanding the underrepresentation of women and racial minorities in STEM requires examining both racial and gender biases as well as how they intersect.

Keywords STEM · Prejudice · Gender gap · Racial discrimination · Academic settings · Intersectionality

Science, technology, engineering, and math (STEM) education and innovation are considered essential for the health and longevity of the United States (White House 2018). For this reason, leadership positions in the STEM fields are among the most influential, lucrative, and prestigious in the nation (National Science Foundation 2013; Pew 2018). In keeping with women's rising share of powerful positions in management and politics (Catalyst, 2018, 2019), the proportion of women earning doctorates in many STEM fields has increased considerably over recent decades. According to annual survey data collected by the National Science Foundation, the percentage of women earning doctorates in engineering as well as physical and earth sciences in the United States increased by five points in the last 5 years, although the proportion of women earning doctorates in mathematics and computer sciences only grew by 1% in that time (National Science Foundation 2017a).

However, despite the increased proportion of female doctorate recipients in many STEM fields, women remain underrepresented among STEM university faculty compared to their male counterparts. Across all science and engineering fields, women compose 42.5% of assistant professors and just

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24.5% of full professors at four-year colleges and universities in the U.S. (National Science Foundation 2018). The gap between the representation of women STEM Ph.D. recipients and women tenured or tenure-track faculty in STEM is likely due to myriad variables, including supply and demand-side factors that involve the interaction of individual decisions with social and cultural constraints and opportunities (Paustian-Underdahl et al. 2019; Wright et al. 2015).

Because evidence suggests that gender differences in inherent aptitudes for math and science are negligible or nonexistent (Ceci and Williams 2011; Spencer et al. 1999; Tomkiewicz and Bass 2008), much research has investigated social and structural reasons for the underrepresentation of women in academic STEM fields. Some of these include the prevalence of highly masculine organizational cultures that create a hostile climate for women, inadequate parental leave policies for employees, and gender differences in work-family balance and labor (Byars-Winston et al. 2011; Ceci and Williams 2011). One line of research helping to explain the gender gap in STEM centers around long-standing negative stereotypes regarding women's competence in science and math (Moss-Racusin et al. 2012).

Gender Stereotypes and STEM

Stereotypes, or cultural beliefs about individuals based on their social category membership, have profound effects on our behavior toward others. When encountering a member of a social category about which we hold stereotypic beliefs, those beliefs are quickly and efficiently activated and can influence our emotions, thoughts, and actions (Cundiff et al. 2013). Gender and race are the strongest social bases upon which we stereotype others (Wood and Eagly 2010), and they are among the most widely studied by psychologists (Bodenhausen and Richeson 2010). Despite significant cultural shifts in women's roles and opportunities over the last several decades in the United States, stereotypic beliefs about women's and men's traits, roles, occupations, and physical characteristics have remained highly stable (Haines et al. 2016).

Descriptive stereotypes about women and men, or expectations about what women and men are typically like (Heilman 2012), portray women as generally less competent than men (Diekman and Eagly 2000). Words like "intelligent" and "competent" fall into the cluster of positive agentic traits considered typical of men (Abele and Wojciszke 2007; Haines et al. 2016), and not into the cluster of positive communal traits that are seen as typical of women (Carli et al. 2016; Eagly and Karau 2002). The stereotype content model, which examines the perceived warmth and competence of societal groups, also finds that women are generally regarded as less competent than men (Fiske et al. 2002). These global gender stereotypes can negatively affect evaluations of women's scholarly success compared to identical men, especially when the target's research and academic record is in its early stages or is less than "superb" (Steinpreis et al. 1999, p. 524).

Women are also specifically stereotyped as being less competent than men in STEM fields (Smeding 2012; Spencer et al. 1999). For example, teachers and parents believe that boys have more natural talent in math than girls (Eccles et al. 1990; Li 1999). Both women and men adults also rate women as less descriptively similar to successful scientists than men (Carli et al. 2016). In fact, in one study, participants from co-ed universities showed no significant overlap in the traits they ascribed to women and those they ascribed to scientists (Carli et al. 2016). In another study, undergraduates perceived typical computer scientists as having traits that were incompatible with the female gender role (Cheryan et al. 2013). The stereotype that men are typically better in math and science than women is especially strong among men in male-dominated fields and STEM fields (Banchefsky and Park 2018; Nosek and Smyth 2011).

Unfortunately, gender-STEM stereotypes have tangible negative implications for women's success and leadership in these fields by promoting prejudice, stereotyping, and discrimination against women (Beasley and Fischer 2012; Heilman 2012; Spencer et al. 1999; Tomkiewicz and Bass 2008). For example, research has found that both men and women science faculty are less likely to hire a woman candidate compared to an identical man for a laboratory manager position and that this bias is explained by perceptions of the woman as less competent (Moss-Racusin et al. 2012). Research also shows that national gender differences in science and math achievement can be explained by national differences in implicit gender-science stereotypes (Nosek et al. 2007). Specifically, the more a nation's citizens implicitly associate men with science and women with the liberal arts, the greater the gap between female and male adolescents' eighth grade science achievement in that nation (Nosek et al. 2007).

Women's and girls' persistence and felt belonging in STEM are also negatively affected by gender-STEM stereotypes. For example, women facing an experimentally-biased chemistry department expected to feel a diminished sense of belonging, more negative attitudes, and less trust and comfort in that context than did male participants exposed to the same biases (Moss-Racusin et al. 2018), and undergraduate women who have been reminded of gender-STEM stereotypes are less likely to aspire to STEM careers (Schuster and Martiny 2017). The descriptive stereotype that females are less competent in math and science than males has also been found to undercut girls' and women's math and science performance (Shaffer et al. 2013; Schuster and Martiny 2017; Smeding 2012). This may be especially true for women who excel in and are invested in math or science (Ambady et al. 2001; Steinberg et al. 2012) or women who endorse gender stereotypes

(Schmader et al. 2004). In sum, a large body of evidence shows that women are expected to be less competent and successful in STEM fields than men, which may help to explain women's underrepresentation in STEM.

Racial Stereotypes and STEM

Similar to women, there are significant holes in the STEM pipeline for members of certain racial and ethnic groups. Although women only compose about 35% of the full-time STEM faculty at U.S. universities in 2015, the percentage of African American and Latinx American STEM faculty is far smaller and even more disproportionate- at less than 1% (U.S. Department of Education, 2017). Asians and Whites, meanwhile, are overrepresented in the STEM workforce relative to their overall share of the workforce, both in terms of their representation in the U.S. population and among STEM doctorate holders (Kodel 2017). Given the substantive body of empirical evidence indicating that racial and ethnic differences in inherent aptitudes for math and science are nonexistent (Gupta et al. 2011; Jimeno-Ingrum et al. 2009; Weyant 2005), racial stereotyping and discrimination have also been proposed as barriers for the entry, retention, and success of racial and ethnic minorities in STEM (Grossman & Porche, 2014).

In general, Black individuals are stereotyped in ways that are incongruent with perceived success in the STEM fields. African Americans, for example, are stereotyped as less competent than Whites and Asians (Kellow and Jones 2008; Wilson 1996), including in STEM (Blaine 2013). White university students have been found to stereotype their Black counterparts as unqualified for university study (Torres and Charles 2004), and these stereotypes about the limited academic ability of Black students can reduces their intention to major in STEM (Beasley and Fischer 2012; Kellow and Jones 2008).

Latinx individuals are also stereotyped as less competent and lower in STEM ability than Whites and Asians (Blaine 2013; Jimeno-Ingrum et al. 2009). The stereotype that Latinxs are less competent than Whites (Jimeno-Ingrum et al. 2009; Weyant 2005) and do not value formal education (Valencia and Black 2002) also has negative consequences for the academic performance of Latinx students. For example, Latinas' concerns about how professors stereotype the academic ability of their racial/ethnic group is significantly and negatively correlated with their college GPA (Valencia and Black 2002), and middle school Latinx's concerns about being judged on the basis of their race at school are related to low feelings of belonging at school (Sherman et al. 2013).

Individuals of Asian descent, on the other hand, are often expected to be more competent than Whites (Berdahl and Min 2012), and to perform extremely well in STEM fields (Gupta et al. 2011; Ho and Jackson 2001; Jackson et al. 1995). Indeed, in research by Ghavami and Peplau (2013), the most frequent attribute undergraduates used to describe both Asian men and women was "intelligent." Asian Americans are also over-represented in the U.S. STEM workforce and academia (Landivar 2013; U.S. Department of Education, 2017). As with all issues of occupational segregation, this over-representation is likely due to the interaction of multiple factors throughout the social ecology (Wright et al. 2015), including Confucian cultural traditions emphasizing effort, education, and learning as a moral good (Cheng 1997; Li, 2003; Tweed and Lehman 2002). One factor Asian Americans do not have to contend with in preparing for and working in STEM fields, however, is negative stereotypes about their ability and likelihood of success.

Intersection of Gender and Racial Stereotypes and STEM

Stereotype research to date has primarily focused on stereotypes about a single social identity such as ethnicity or gender (Fiske et al. 2002; Ghavami and Peplau 2013; Eagly and Wood 2011; Wood and Eagly 2010). Although research on global stereotypes about gender and race is vast, less is known about how multiple group memberships interact to produce particular stereotype profiles (Ghavami and Peplau 2013). For example, stereotypes about women in general are distinct from stereotypes about professional women (DeWall et al. 2005). Similarly, educated Black people are seen as distinct from Black people in general (Czopp and Monteith 2006), as are Black athletes and musicians (Walzer and Czopp 2011).

The ways in which multiple social identities intersect and interlock to produce unique stereotypes and lived experiences are captured through the concept of intersectionality (Cole 2009; Crenshaw 1989). Psychological research in the last decade finds that perceptions of and experiences at these intersections are emergent rather than additive (Beasley and Fischer 2012), and they cannot be adequately studied individually. Moreover, studying the effects of belonging to social categories in isolation from one another results in the systematic understudy of certain minority groups, such as those who are not considered prototypical for a single social group (Cole 2009). Studying barriers to STEM from an intersectional framework provides the possibility of narrowing the gender and racial gaps in a way that addresses the multifaceted deterrents of full STEM inclusion (Metcalf et al. 2018).

To our knowledge, no research to date has examined perceptions of STEM scholars based on simultaneous variability in their gender and racial identities. This is problematic because it creates overly broad classifications that may not apply to those who are negatively affected by two discursive groups (Steinbugler et al. 2006). The intersecting categories of race and gender can create a unique set of stereotypes that cannot be calculated by summing their parts, and they can create both oppression and opportunity (Ghavami and Peplau 2013; Steinbugler et al. 2006). Consistent with intersectionality theory, the results of a study conducted by Ghavami and Peplau (2013) that examined and compared individuals' existing perceived cultural stereotypes of 10 different gender-by-ethnic groups (e.g., Black women or Asian American men) found that different gender-by-ethnic group stereotypes contained unique elements that were not merely additive of gender stereotypes and ethnic group stereotypes. For example, a White man likely enjoys certain societal benefits because of his privileged gender and racial status. Additionally, because social categories are cross-cutting, individuals can concurrently benefit from particular identities and be disadvantaged by others (Ghavami and Peplau 2013; Steinbugler et al. 2006). For example, a Black man may benefit in some ways from his gender, but be marginalized in other ways on account of his race. Examining the intersection of race and gender allows for understanding how race and gender simultaneously operate to produce unique perceptions of individuals belonging to multiple disadvantaged groups and how different levels of gender and racial group membership interact to produce distinct levels and forms of bias (Kennelly 1999).

Although no known study to date has examined the simultaneous role of racial and gender identities in STEM hiring discrimination, there is a small, growing body of literature examining these intersections in other industries. For example, some research shows that employers hold slightly more favorable attitudes toward hiring Black men than Black women (Steinbugler et al. 2006). This may be because stereotypes that portray Black women as single mothers, unreliable, and ill-prepared are still commonly held beliefs in the labor market (Kennelly 1999; Steinbugler et al. 2006). Employers in certain industries may also hold more favorable attitudes toward Latino men than toward Latina women (Jimeno-Ingrum et al. 2009). For example, the number of Hispanic/Latina women who hold positions in higher education is even less than the number of Hispanic/Latino men (U.S. Department of Education 2018). Based on existing stereotype research, it seems that the intersection of marginalized gender and racial group identities may lead to lower perceptions of competence. Thus, Latina women and Black women may be perceived as the least competent in the STEM fields compared to all of the other intersecting racial and gender groups (Steinbugler et al. 2006), a result of the stereotypes associated with their intersecting minority statuses.

The Current Study

The primary purpose of the current study is to examine how STEM candidates' gender and race, combined, influence perceptions of STEM professors who evaluate those candidates. Specifically, we examine U.S. biology and physics professors' perceptions of the hireability and competence of post-doctoral candidates for a tenure-track assistant professor position in their same field, based on the candidate's race and gender. We modeled our study after landmark studies on job discrimination in the evaluation of curriculum vitae (CVs) and resumes (e.g., Moss-Racusin et al. 2012; Steinpreis et al. 1999), in which the applicant name on a single resume or CV was varied while all else was held constant.

Based on the stereotype content model (Fiske et al. 2002), as well as previous research examining faculty gender biases in STEM (Moss-Racusin et al. 2012), we predict that male post-doctoral candidates, overall, will be rated as higher in competence and hireability than female post-doctoral candidates across physics and biology departments (Hypothesis 1). We also predicted that White and Asian candidates would be rated as more competent and hireable than Black and Latinx candidates across departments (Hypothesis 2). Furthermore, consistent with intersectionality theory and prior research, we predict that the White and Asian male candidates, coming from multiple social backgrounds associated with success in STEM, would be seen as the most competent and hireable of all race-by-gender targets, whereas women candidates from Black or Latina backgrounds, who face multiple descriptive expectations to be low in STEM aptitude, would be rated the least competent and hireable of all race-by-gender targets (Hypothesis 3). Because some previous research suggests that highly male-dominated fields are associated with greater gender bias and inequity (Cheryan et al. 2017; Riegle-Crumb and King 2010), we also predict that the gender biases we observe would be attenuated by department, with faculty from biology departments showing a weaker preference for male post-doctoral candidates than faculty from physics departments (Hypothesis 4).

Although we had no further formal hypotheses, we also assessed perceptions of candidates' likeability. Research on descriptive stereotypes suggests that female candidates may be seen as generally more likeable than male candidates because communal traits, such being as caring and unselfish, are believed to be more typical of women than men (Carli et al. 2016; Wade and Brewer 2006). However, the women targets being assessed were working in gender counter-stereotypic fields and demonstrating some competence in that field, potentially resulting in backlash. *Backlash* includes negative social and economic reactions individuals receive for violating prescriptive and proscriptive norms (i.e., role-congruent "shoulds" and "should nots"; Moss-Racusin et al. 2010; Rudman and Phelan 2010), such as women exhibiting high levels of agency (Rudman et al. 2012). Thus, female targets in STEM may be rated as less likeable than their male counterparts. Similarly, the ways race, as well as gender and race together, would affect ratings of candidates' likeability was left open. In sum, we analyzed candidates' perceived likeability in an exploratory fashion.

Method

Pretesting

Creation of the Department CVs

Social science literature suggests that stereotypes are most likely to be expressed in the evaluation of ambiguous or average targets (Barrantes and Eaton 2018; Moss-Racusin et al. 2012; Steinpreis et al. 1999), which allow for multiple interpretations. For this reason, the physics and biology CVs in the current study were constructed to represent candidates whose qualifications were average overall, but who also had conflicting indications of competence. To ensure that the physics and biology CVs both represented average postdoctoral candidates with regard to positions at large, public universities of the Highest Research Activity (R1s), we undertook extensive pretesting at a large, public U.S. R1 not included in the final pool of participating universities.

First, using input from multiple physics and biology faculty, we identified two very common subfields in physics and biology: nuclear physics and evolutionary biology, respectively. These subfields were chosen so that the faculty participants in our study would have the greatest opportunity possible to feel qualified to render judgments on the CV and the candidate's hireability and competence. Next, we solicited input on CV content from two physics subject matter experts (a tenured man and a tenured woman physics professor at the R1 used in pretesting) and two biology subject matter experts (a tenured man and a tenured woman biology professor from the same R1). These subject matter experts (SMEs) were unaware of our study's hypotheses, and they were told the research team needed assistance in creating "average" CVs for recent Ph.D. graduates in their respective fields. The SMEs also provided the research team with CVs of recent doctoral graduates from their departments who had successfully attained post-doctoral positions at a large public, R1 university. Similar to work by Steinpreis and colleagues (Steinpreis et al. 1999), the bases of the biology and physics CVs came from real-life scientists, including real journal titles and national conferences. Together, this content was used to draft a CV for the biology and physics post-doctoral candidates. The CVs were revised multiple times following the suggestions from the SMEs before quantitative pretesting.

Ambiguity in CVs' Indicators of Competence

Approximately 60% of the content in the CVs (publications, conference presentations, the quality of the doctoral program, etc.) was crafted to represent the competitiveness of an average-level candidate. For example, the number of publications on the Physics CV (23 publications, 3 first-author) and on the Biology CV (4 publications, 3 first-author) and their journal titles were seen as average by the SMEs. However, as we mentioned previously, findings in similar studies (e.g., Barrantes and Eaton 2018; Steinpreis et al. 1999) have indicated that rater biases are expressed to a greater extent when evaluating candidates whose performance is ambiguous or still emerging. Thus, 20% of the remaining content in the CVs was intended to represent noticeably superior signs of achievement that indicate excellent performance, and the remaining 20% was intended to represent "red flags" indicating poor performance/low competence. As an example of excellent performance, the candidate won a dissertation year fellowship from their university and attended M.I.T. as an undergraduate. As indicators of possible low performance, the candidate took 10 years to complete their Ph.D. and did not have any significant external grant funding.

CV Pretest Results

After the CVs for each department were created with and approved by the SMEs, they were quantitatively pretested using a sample of 19 tenured and tenure-track biology professors and 15 tenured and tenure-track physics professors employed at the same R1 from which the SMEs were drawn. Pretest participants were asked to indicate the competitiveness of the publication record section, the grants and award section, and the honors section of the candidate's CV, as well as their "overall perception of the applicant's competence" on 9-point Likert-type scales. Two short-answer items were also included to ensure faculty in both departments were able to identify the notable accomplishments and red flags included in each CV.

The pretest of both CVs yielded mean ratings of overall candidate competence that were in the middle of the 9-point scales (Biology $M = 5.83$, $SD = 1.20$; Physics $M = 6.00$, $SD = 1.81$). When these means were tested against the scale mid-point of 5, Physics professors' ratings of the candidates' competence were not found to differ significantly from the mid-point, $t(14) = 2.13$, $p = .051$. Although Biology professors rated the candidate as significantly above the mid-point of 5, $t(17) = 2.95$, $p = .009$, the scores clustered close to the mid-point (one standard deviation above and below the mean ranged from 4.63 to 7.03). An independent-samples t-test with faculty department as the independent variable and overall CV competence as the dependent variable indicated that the Biology CV did not significantly differ from the physics CV in faculty perceptions of overall candidate competitiveness, $t(31) = .31$, $p = .75$. (See the online supplement for final CVs.)

Candidate Name Pretest Results

The eight candidate names selected to represent the eight race/gender conditions were generated by choosing among the most common first and last names indicated in the 2010 United States Census Bureau (U.S. Census Bureau, 2010) for each of the eight race/gender groups. The names were as follows: Bradley Miller (the White male condition), Claire Miller (the White female condition), Zhang Wei [David] (the Asian male condition), Wang Li [Lily] (the Asian female condition), Jamal Banks (the Black male condition), Shanice Banks (the Black female condition), José Rodriguez (the Latino male condition), and Maria Rodriguez (the Latina female condition).

The eight first and last name combinations were pretested using a new sample of 20 biology and physics faculty members from the same university where the CV pretesting was done. Using a within-subjects design, the 20 biology and physics pretest faculty were asked to indicate if each of the eight candidate names was a male or female and whether it was perceived as indicating a White, Latinx, Black, or Asian candidate. Results of the name pretesting showed that 100% of faculty member participants accurately indicated the intended race and gender of each of the first and last name combinations. Thus, the name pretesting supported our use of the eight race/gender name combinations in our study to indicate the intended gender and race of the candidate.

Study Design

Our actual study employed a fully-crossed between-subjects experimental design, using a large sample of U.S. male and female biology and physics professors to understand how the race and gender of post-doctoral candidates affects STEM professors' evaluations of these candidates' competence and hireability. We asked STEM professors in the Physics and Biology departments of eight public research universities in the United States to read and evaluate the CV of a recently graduated, hypothetical Ph.D. student in their respective fields (physics and biology) who was looking for a post-doctoral position. The CVs varied only in terms of the gender (female vs. male) and ethnicity (White vs. Latinx vs. Black vs. Asian) of the candidate, which were indicated by the candidates' first and last name.

Our participant pool included tenured and tenure-track professors in the Physics and Biology departments at eight large (i.e., more than 25,000 students), public, very high research (RUVH), mostly-urban, U.S. universities that did not have NSF ADVANCE IT grants as of mid-2016. Large universities were chosen because they have large faculty bodies from which we could sample. Universities in the same research tier were chosen so that the standards for scholarly success across schools were relatively uniform, allowing us to construct CVs of recent graduates targeted at the average level of productivity for these types of schools. We chose RUVH schools because these universities have the least diverse faculty bodies and yet are key organizations for advancing women and minorities into high-level research positions in their fields Schools from across the nation were selected to make the results generalizable. Schools that had not had NSF ADVANCE IT grants were chosen because these schools may be less likely to guess the purpose of the study and because these schools have not yet benefitted from ADVANCE IT grant consciousness-raising designed to increase the participation and advancement of women pursuing academic science and engineering careers (National Science Foundation 2017b).

Prior research demonstrates a moderate effect of candidates' gender on STEM professors' perceptions of candidates' competence (Moss-Racusin et al. 2012). Thus, in order to detect an effect of .03 (small η_p^2) with .80 power, .05 probability, and 16 cells in a 2 (department: physics or biology) × 2(candidate gender: male or female) × 4(candidate race: White, Latinx, Black, or Asian) between-subjects design, we attempted to achieve 14 individuals per cell for a total of 230 professors, 115 from each of the two departments. The total number of tenured and tenure-track physics professors at the institutions from which we recruited was 239 (M = 29.88, SD = 9.11, range = 13–41), and the total in biology was 428 (M = 53.50, SD = 28.94, range = 24–106), making a total of 667 professors in both departments across all eight universities. However, 32 of the 667 mailed surveys sent to these faculty were returned for invalid addresses and were removed from our final participant pool, resulting in a final pool of 635 eligible physics and biology faculty members.

To maximize the response rate for each department to attain a sufficiently large sample size of faculty participants from each department, a $5.00 cash incentive was mailed to each of the 635 potential faculty participants in the participant pool along with a consent form, a survey, and a random version of the CV in their field. All procedures were approved by the Social and Behavioral Sciences IRB at the first author's institution.

Participants

Of the 635 tenured and tenure-track faculty in the participant pool who were mailed surveys and study materials, a total of 251 faculty from both departments mailed back completed surveys and were included as participants in our study, making a response rate of 39.37% across departments. Based on precedents in the literature (e.g., Moss-Racusin et al., 2012; Steinpreis et al. 1999), our attained response rate was typical and sufficiently representative. Of the 251 faculty participants included in our sample who completed the survey, 157 (62.55%, 38% response rate) were from a biology department and 94 (37.45%, 41% response rate) were from a physics department. Across both departments ($n = 190$), 22% ($n = 43$) of respondents self-identified as female and 78% ($n = 147$) self-identified as male. When examined by discipline, 90% ($n = 84$) of those in the physics department indicated they were men, as did 65% ($n = 63$) of those in the biology department. Regarding professional status, 57.22% ($n = 103$) of the faculty in the sample reported having the position of Full Professor, 26.11% ($n = 47$) were associate professors, 13.33% ($n = 24$) were assistant professors, and 3.33% ($n = 6$) reported having another tenured or tenure-track professional status. Lastly, nearly all ($n = 225$, 89.62%) of the faculty in the sample reported having previous experience hiring a post-doctoral candidate at least once.

The gender and racial composition of male and female faculty members included in the study were very similar to the national average gender compositions for physics and biology departments (National Science Foundation 2014), with the majority of faculty being men in both departments and with the physics department being particularly male-dominated compared to the biology department. Recent research shows that, on average, 16% of physics faculty are women (Ivie 2018), and nearly 90% of physics doctoral degrees earned in the United States between 2014 and 2016 were earned by White students (Ivie 2018). In 2016, only 1.5% of physics faculty were Black and 3.3% identified as Latinx (Ivie 2018).

Materials, Procedure, and Measures

Participants were first instructed to read and sign the consent form. They were then asked to carefully review the CV they were sent, which was described as "…a hypothetical CV that was developed by combining various CVs of actual postdoctoral associates in your field. Please keep in mind that this is a fictitious CV and not an actual individual." In order to help reduce demand characteristics and socially desirable responding, participants were instructed that the main purpose of the study was to examine how CV formatting and design styles influenced science faculty's perceptions of postdoctoral candidates. To support this cover story, four questions on the format of the CV were included at the beginning of the survey before participants assessed the hireability, competence, likeability, and competitiveness of the post-doctoral candidate. To further support our cover story, the research interests of the third author, who was described as the study's principal investigator (PI), were altered while the study was running to reflect an interest in CV and resume formatting. Thus, any participants who searched online for the PI's research interests would have found interests that matched the study's ostensible purpose.

Once the faculty participants were finished reading the enclosed CV, they were instructed to complete the attached survey. Participants first answered four items that examined their perceptions of the format and design of the CV as part of the cover story. Next, participants completed items measuring their perceptions of the post-doctoral candidate's overall competitiveness, the likelihood he/she would be hired at their institution, and measures of his/her competence and likeability. Participants were then instructed to mail back their completed consent form, survey, and the CV using a stamped envelope provided to them and addressed to the third author's student mailbox.

CV Formatting

Four items at the beginning of the survey were used to assess participants' perceptions of the formatting of the CV. The items were: (1) "How easy was it for you to navigate the CV?," (2) "How complete or comprehensive was the information in the CV?," (3) How professional was the CV?," and (4) "How well-designed was the CV?" These items were not included in our analyses because they were only part of the cover story and did not represent variables of interest.

Competence

Ratings of the candidate's competence were created by using the composite score from three items borrowed from Moss-Racusin and colleagues (Moss-Racusin et al. 2012). The items were: (a) "Based on the CV you read, did the candidate strike you as competent?," (b) "How likely is it that the candidate has the necessary skills for a postdoc job?," and (c) "How qualified do you think the candidate is?". Participants used 9-point Likert-type scales to respond to these items, from 1 (*not at all*) to 9 (*very much*). Scores were averaged across items such that higher scores denoted greater perceived competence. Internal reliability for the competence composite was high ($\alpha = .92$).

Hireability

Faculty ratings of the candidate's hireability were created by using the composite score of three hireability items from Moss-Racusin and colleagues (Moss-Racusin et al. 2012). Participants responded to the following three questions using a 1 (*not at all likely*) to 9 (*very likely*) Likert-type scales: (a) "How likely do you think it would be for the candidate to make the 'first cut' (be in the top tier of candidates) if they applied to an open postdoc position at an institution like yours (large, public, R1)?"; (b) "How likely do you think it would be for the candidate to be selected for an interview if they applied to an open postdoc position at an institution like yours?"; and (c) "How likely do you think it would be for the candidate to be extended an official offer for an open postdoc position at an institution like yours?" Scores were averaged across items such that higher scores denoted greater perceived hireability. Internal reliability for the hireability composite was high ($\alpha = .94$).

Likeability

Similar to the measure of competence, faculty ratings of candidate likability were calculated using the composite score of three likeability items drawn from Moss-Racusin and colleagues (Moss-Racusin et al. 2012). The three items were: (a) "Based on the CV you read, how much you did like the candidate?"; (b) "Would you characterize the candidate as someone you want to get to know better"; and (c) "Would the candidate fit in well with other faculty members at your institution?" Participants responded to these items using Likert-type scales from 1 (*not at all*) to 9 (*very much*), and internal consistency reliability for the likeability composite was high ($\alpha = .93$). Scores were averaged across items such that higher scores denoted greater perceived likeability.

Results

Preliminary Analyses and Analysis Plan

Data were first evaluated for missingness, skewedness, kurtosis, and outliers. A missing value analysis yielded a nonsignificant value, Little's MCAR $\chi^2(8) = 5.52$, $p = .70$. The multiple imputation function in SPSS was used to impute values for independent variables with missing values (see Treiman 2009, for a description of Bayesian multiple imputation). Ten imputed datasets were created and pooled for our subsequent analyses. Percentage of missing data on dependent variables ranged from 12.6% to 16.7%. Multiple imputation has been shown to provide unbiased estimates and standard errors when missing data are either missing completely at random or missing at random, and the amount of missing data ranged from 10 to 20% (Schlomer et al. 2010).

To examine our hypotheses, data were analyzed in a three-way factorial MANOVA with department, candidate gender, and candidate race as the independent variables as well as composite scores representing candidate competence and hireability as the two dependent variables. Along with main effects of race and gender (Hypotheses 1 and 2), our model included a two-way interaction between race and gender (Hypothesis 3) and between gender and department (Hypothesis 4). We performed bootstrapping with 1000 resamples to allow for correlated error terms.

Hypothesis 1: Candidate Gender

Our results indicated a significant main effect of candidate gender across both departments and all experimentally manipulated target ethnicities on competence ratings, $F(1, 246) = 11.18$, $p < .001$, $\eta_p^2 = .05$. Consistent with a large body of previous literature (Eagly and Mladinic 1994; Moss-Racusin et al., 2012; Steinpreis et al. 1999), faculty participants rated the male candidates as being significantly more competent than the equally qualified female candidates when averaging across faculty departments, lending support to Hypothesis 1. Further supporting Hypothesis 1, results from the three-way factorial MANOVA, with candidate gender, candidate race, and faculty department as the independent variables and candidate hireability as the dependent variable, indicated a significant main effect of candidate gender on faculty ratings of hireability across departments and candidate ethnicities, $F(1, 246) = 7.98$, $p = .005$, $\eta_p^2 = .03$. Men were viewed as significantly more hireable than their female counterparts. Although exploratory, our analysis of likeability by gender showed a significant main effect, $F(1, 246) = 3.94$, $p = .048$, $\eta_p^2 = .02$. Women were rated as significantly more likeable than men. The mean competence, hireability, and likeability scores by gender along with associated p-values and effect sizes are reported in Table 1.

Hypothesis 2: Candidate Race/Ethnicity

In addition to the significant main effect of gender on faculty ratings of candidate competence and hireability, there also were significant main effects of candidate race on ratings of competence, $F(3, 246) = 7.78$, $p < .001$, $\eta_p^2 = .09$, and candidate hireability, $F(3, 246) = 10.77$, $p < .001$, $\eta_p^2 = .12$, as predicted by Hypothesis 2. White and Asian candidates were rated as more competent and hireable than Black and Latinx candidates across departments. Likeability ratings were not found to differ significantly by applicant race, $F(3, 246) = .12$, $p = .95$, $\eta_p^2 = .001$. Mean competence, hireability, and likeability ratings by race along with associated p-values and effect sizes are reported in Table 1.

Hypotheses 3 and 4: Intersections and Department Comparisons

Contrary to Hypothesis 3, there were no significant interactions between race and gender on perceived competence, $F(3, 243) = 1.01$, $p = .39$, or hireability, $F(3, 243) = 1.13$, $p = .33$. We returned to this finding after testing Hypothesis 4. Results for Hypothesis 4, examining the interaction between department and gender, indicated that faculty department moderated the effect of candidate gender on composite ratings of competence, $F(1, 246) = 5.45$, $p = .02$, $\eta_p^2 = .02$. More specifically, faculty participants in the physics department rated male

Table 1 Descriptive statistics and gender and racial/ethnic group comparisons

	Candidate		Gender	Candidate				Asian vs.		White vs.	
	Male *M (SD)*	Female *M (SD)*	Comparison *p, d*	Asian *M (SD)*	White *M (SD)*	Black *M (SD)*	Latinx *M (SD)*	Black *p, d*	Latinx *p, d*	Black *p, d*	Latinx *p, d*
Competence Rating											
Overall	7.18 (1.40)$_a$	6.66 (1.58)$_b$	.006, .35	7.29 (1.41)$_c$	7.42 (1.16)$_c$	6.32 (1.64)$_d$	6.65 (1.55)$_d$	<.001, .63	.02, .43	<.001, .77	.003, .56
By Physics Faculty	7.46 (1.21)$_a$	6.21 (1.73)$_b$	<.001, .84	7.42 (1.20)$_c$	7.46 (1.10)$_c$	6.22 (1.98)$_d$	5.89 (1.59)$_d$	.008, .73	.002, 1.09	.004, .77	< .001, 1.15
By Biology Faculty	7.02 (1.48)$_a$	6.93 (1.43)$_a$	.70, .06	7.20 (1.53)$_{c,e}$	7.40 (1.22)$_c$	6.37 (1.42)$_d$	6.94 (1.45)$_{c,d,e}$	.014, .56	.42, .17	.003, .78	.16, .34
Hireability Rating											
Overall	6.48 (1.90)$_a$	5.89 (1.96)$_b$	.03, .31	7.04 (1.51)$_c$	6.64 (1.62)$_c$	5.62 (2.28)$_d$	5.69 (1.93)$_d$	< .001, .73	.001, .78	.002, .52	.004, .53
By Physics Faculty	6.93 (1.77)$_a$	5.08 (2.23)$_b$	<.001, .92	6.86 (1.68)$_c$	6.92 (1.51)$_c$	5.44 (2.68)$_d$	4.22 (1.87)$_d$	.018, .63	<.001, 1.49	.008, .68	<.001, 1.59
By Biology Faculty	6.20 (1.94)$_a$	6.57 (1.54)$_a$	.18, .21	7.14 (1.41)$_c$	6.41 (1.70)$_{c,e}$	5.73 (2.03)$_e$	6.26 (1.64)$_{c,e}$	< .001, .81	.69, .13	.09, .36	.70, .09
Likeability Rating											
Overall	5.88 (1.46)$_a$	6.29 (1.21)$_b$	<.001, .31	6.11 (1.29)$_c$	6.04 (1.24)$_c$	5.89 (1.52)$_c$	6.27 (1.38)$_c$	.38, .15	.51, .12	.54, .11	.33, .18
By Physics Faculty	5.85 (1.50)$_a$	6.07 (1.31)$_a$	.45, .16	6.03 (1.32)$_c$	6.03 (1.49)$_c$	5.94 (1.44)$_c$	5.78 (1.44)$_c$	.83, .07	.58, .18	.82, .06	.70, .17
By Biology Faculty	5.90 (1.45)$_a$	6.42 (1.13)$_b$	.02, .40	6.16 (1.29)$_c$	6.05 (.99)$_c$	5.86 (1.59)$_c$	6.47 (1.32)$_c$	.33, .21	.30, .24	.56, .14	.56, .36

Means with different subscripts are significantly different across a row (a) within gender (i.e., comparing ratings of male and female candidates) and (b) within racial/ethnic groups (i.e., comparing ratings of Asian, White, Black, and Latinx candidates)

candidates as significantly more competent than female candidates (see Table 1). Faculty participants' in the biology departments competence ratings of male candidates did not significantly differ from their competence ratings of female candidates. Likewise, the interaction between faculty department and ratings of hireability was also significant, $F(1, 246) = 15.94$, $p < .001$, $\eta_p^2 = .07$. Faculty participants in the physics department rated male candidates as significantly more hireable than female candidates, whereas faculty in the biology department rated male and female candidates similarly (see Table 1). Thus, consistent with Hypothesis 4, our results indicated that only physics faculty appeared to exhibit gender bias favoring male candidates in terms of both perceived competence and hireability. Faculty department did not moderate the effect of candidate race, $F(3, 246) = 1.13$, $p = .34$, or gender, $F(1, 246) = .48$, $p = .49$, on likeability.

Although there was a significant main effect of candidate race on ratings of competence across departments, there was not a significant interaction between candidate race and faculty department on ratings of competence, $F(3, 243) = 2.04$, $p = .11$. There was, however, a significant interaction between candidate race and faculty department on hireability, $F(3, 246) = 4.89$, $p = .03$, $\eta_p^2 = .06$. More specifically, faculty in the physics department exhibited a significant racial bias favoring Asian and White candidates as more hirable compared to equally qualified Black and Latinx candidates (see Table 1). Those in biology also demonstrated a significant racial bias in hireability, favoring the Asian candidates as more hirable than equally qualified Black candidates. However, this was the only significant racial bias in hireability exhibited by biology faculty. Moreover, no significant three-way interaction was found among participant department, candidate race, and likeability, $F(3, 243) = 1.13$, $p = .33$.

Exploratory Tests

Given the null finding for Hypothesis 3 and partial support for Hypothesis 4 such that certain racial and gender groups were rated lower by professors in physics, we examined whether a three-way interaction among department, applicant gender, and applicant race would reveal differences in ratings of competence and hireability for Latinas and Black women compared to White and Asian women as well as all men, regardless of men's race. Indeed, there was a significant three-way interaction among department, applicants' gender, and applicants' race on hireability, $F(3, 243) = 3.05$, $p = .03$ $\eta_p^2 = .04$. Black ($M = 4.29$, $SE = .46$, $p < .001$) and Latinx ($M = 3.87$, $SE = .54$, $p < .001$) female candidates, as well as Latino male candidates ($M = 4.67$, $SE = .61$, ps = .048 to < .001), were rated significantly lower than all other candidates (Ms ranged 5.93–7.42) by physics faculty. The three-way interactions on competence, $F(3, 243) = 2.12$, $p = .09$, $\eta_p^2 = .03$, and likeability, $F(3, 243) = 1.34$, $p = .25$, $\eta_p^2 = .02$, were not significant. All means by gender, race, and faculty department appear in supplementary Table 1 s. Boxplots displaying competence, hireability, and liking composite ratings for each candidate CV in each department also are available in the online supplement.

Discussion

The present study examines how U.S. university professors' perceptions of STEM post-doctoral candidates are affected by gender and racial stereotypes. The present work goes beyond previous examinations of stereotypes about STEM workers by applying an intersectional lens by exploring perceptions of men and women STEM scholars in multiple racial/ethnic identities across two STEM domains. We experimentally manipulated the racial and gender identities on the CVs of a postdoctoral scholar applicant in either biology or chemistry. Our hypotheses were generally supported by the data. A gender bias (in physics), a racial bias (in both physics and biology), and compounded gender and racial biases (in physics) were evident in professors' evaluations of ambiguously qualified post-doctoral candidates.

First, male post-doctoral candidate CVs were evaluated more favorably by STEM professors in general, although this effect was moderated by faculty department. Male favoritism in the evaluation of STEM scholars is consistent with previous evidence demonstrating gender bias in lab manager applications (Moss-Racusin et al., 2012), yet is potentially more damaging because postdoctoral positions are increasingly necessary for becoming a tenure-track research faculty member and achieving the most prestigious opportunities in the field. However, it is critical to note that only physics faculty, not biology faculty, exhibited a general gender bias in their evaluations of the candidates' competence and hireability. This moderation by department was expected because biology is a more gender-balanced field than physics (Cheryan et al. 2017).

The increased gender bias in physics compared to biology may be due to a host of factors. First, physics departments may have more masculine cultures than biology departments, potentially privileging male over female applicants (Cheryan et al. 2017). Second, a large body of research suggests that although both men and women hold sexist attitudes and gender stereotypes, men hold stronger gender biases than women do (Glick and Fiske 2001). Because 90% of our participants in physics were men, compared with only 65% of participants in biology, the gender bias observed in physics may be due, at least in part, to participants' gender. Unfortunately, we were not able to examine the potential moderating effects of participants' gender on our dependent variables because there were too few women faculty in our sample to examine interactions among department, participants' gender, targets' gender, and targets' race. Third, the presence of a gender bias in physics, and not biology, may be due to the fact that physics is seen as a "harder" science than biology—one requiring very high levels of mathematical and analytical intelligence (Hazari et al. 2007). Thus, the gender bias in physics may be due to a greater presumed lack of fit between beliefs about typical women candidates and the requirements of physics positions compared to biology positions. All of these explanations may also operate simultaneously, and they should be examined in future research.

The second main finding in the current study is that faculty members in both departments demonstrated racial biases. Biases in candidates' competence were similar in both departments, where Asian and White candidates were seen as more competent than Black candidates. In terms of hireability, faculty in physics rated Asian and White candidates as more hirable compared to Black and Latinx candidates, whereas those in Biology rated the Asian candidates as more hirable than the Black candidates. Our third finding, consistent with intersectionality theory, was evidence for compounded gender and racial biases among candidates in physics. Specifically, Black and Latina female candidates, and Latino male candidates, were rated significantly lower than all other candidates on the measure of hireability by physics faculty.

Taken together, our findings lend experimental support to the double bind and unique challenges faced by Women of Color in science. Prior research has found that Women of Color not only experience the bias patterns encountered by White women, but also report biased experiences that differ from those of White women (Williams and Dempsey 2014). For example, Black women are more likely to experience isolation in the academy than White women (Williams and Dempsey 2014). Latinas, meanwhile, report levels of disrespect and accent discrimination not reported by other women (Williams and Dempsey 2014).

Limitations and Future Research

Although the current study helps shed new light on how faculty's biases may impede women and underrepresented minority members from advancing in STEM disciplines, particularly in physics, there are some limitations in the current research. First, although we examined how candidates' race and gender affected STEM faculty's ratings of post-doctoral candidates, one of the main limitations was our inability to analyze participants' gender and race because doing so would have greatly reduced the statistical power of our model. Examining how raters' own social identities may impact the expression of stereotypes, including the extent to which they share identities with a target, will be an important task for future research on biases in STEM. Additionally, the attenuating effect of department on racial and gender stereotypes in the current study suggests that studying additional STEM departments, as well as mediators of departmental differences in biased evaluations, will be important for theory and practice moving forward.

Next, we derived our predictions in the present paper from literature on descriptive stereotypes (i.e., stereotypes about what is typically true of group members) rather than on prescriptive stereotypes (i.e., stereotypes about how group members ought to be; Prentice and Carranza 2002). Specifically, we expected the descriptive stereotypes that women and underrepresented racial/ethnic minorities are less competent in STEM than their counterparts would serve a heuristic or energy-saving function (Heilman 2012) in the evaluations of complex CVs that did not give the reader a clear sense of the target's competence. Whereas descriptive stereotypes about the competence of women and racial/ethnic minorities are well known (Fiske et al. 2002), there may also be prescriptive stereotypes about the competence of these groups in STEM that lead to backlash (Moss-Racusin et al. 2010). Future research should further examine the effects of descriptive and prescriptive stereotypes on evaluations of underrepresented groups in STEM, including the extent to which prescriptive stereotypes about women's competence and STEM abilities might produce backlash. Our exploratory findings on candidates' likeability, in which women candidates were seen as more generally likeable than men, suggest that women STEM candidates were not penalized in terms of their perceived warmth. However, this is not conclusive evidence for lack of a backlash effect because our candidates did not demonstrate clearly superior achievement and ability that would violate prescriptive norms for women and minorities to be less intelligent and capable in STEM.

One potential criticism of our paper is that our CVs were rather weak, generally sending a "don't hire me" signal in today's highly competitive job market. Specifically, the red flags in our CVs might be interpreted as "bias amplifiers" (Tetlock and Boettger 1989), leading faculty to be especially suspicious of candidates with this mixed constellation of qualities and to rely more heavily on stereotypes than they might otherwise. Indeed, we constructed CVs that were intentionally less than stellar and included some obvious drawbacks. Nonetheless, the pretesting we performed with R1 physics and biology faculty indicated that the CVs were rated as slightly more competitive than average, with mean pretest ratings of "competitiveness" being above the scale midpoint for both the biology and physics CVs. Second, although participants in our study came all came from R1s where the majority of faculty participants had actual experience with hiring post-doctorates, they were not among the top 20 R1s, where the CVs we created might have been seen as especially low in quality or problematic. The overall means for the competence and hireability of the CVs in our study support this interpretation.

A final issue to consider when situating our study in the broader literature is the seeming divergence between our findings and those from studies that do not reveal biases against female applicants for academic positions in STEM (Ceci and Williams 2015; National Research Council 2009; Williams and Ceci, 2015). For example, experimental work by Williams and Ceci (2015) found that faculty in biology, engineering, and psychology significantly preferred women applicants for assistant professor positions relative to men. We believe the apparent disjuncture between our findings and theirs can be resolved by considering the difference in the strength of the application materials used in each study.

Williams and Ceci (2015) had professors evaluate applications for tenure-track positions that were "unambiguously strong," whereas we intentionally developed materials that were ambiguous in quality. It has been long known that stereotypes are most likely to guide information processing and evaluation in ambiguous situations, serving a schematic function (Barrantes and Eaton 2018; Heilman 2012). In this way, Williams and Ceci demonstrate a boundary condition in the application of gender stereotypes by showing that scholars with exceptionally strong records may be exempt from biases in favor of men and, in fact, that excellent members of underrepresented groups may have a hiring advantage. Indeed, men may not be prejudicially favored over women in STEM when both are equally and highly qualified (Williams and Ceci, 2015) or when clear differences in strength between applicants exists (Ceci and Williams 2015). However, when adjudicating among moderately and equally qualified candidates, men may be prejudicially advantaged. Because most Ph.D. graduates have records that are moderate in quality, and include both achievements and limitations, this is concerning, and adds support to the adage that the evidence of true gender equity will be "…when there will be equal numbers of mediocre women [in positions of power] and mediocre men" (McIntosh 1985, p. 4).

Practice Implications

Many factors contribute to the maintenance of the gender and racial gap in STEM, including push-and-pull factors ranging from perceived ability to familial pressures (Watt et al. 2017). The present work adds to the body of knowledge showing that one likely contributor to this gap is prejudice in the evaluations of women and underrepresented racial/ethnic minority STEM scholars. To the extent that STEM professors see individuals of a certain gender and race as less competent and hireable for STEM post-doctoral roles, they should be less likely to recruit and hire such individuals. Ironically, biases in recruitment and hiring can lead to a disproportionately low representation of women and minorities in the STEM profession, reinforcing the perception that they are not appropriate for or successful in these positions (Moss-Racusin et al. 2012).

One practical implication of our findings is that change to evaluative processes and practices may be needed to counteract gender and racial bias in STEM hiring (Sax et al. 2016). Several empirically tested interventions have improved engagement at the undergraduate level for women and Black students (Smith et al. 2012; Walton et al. 2015, but additional interventions are needed to ensure women and minorities are fairly evaluated and consistently engaged at the postdoctoral level and beyond. One way to do this might be to have STEM job candidates submit materials that do not include their full names, but only surnames, which are inevitably present in citations of publications and presentations. This may reduce the operation of gender biases in the evaluation of candidates' materials, although racial biases may still emerge as the result of racially or ethnically linked surnames. Letter writers may also wish to remove clear references to candidates' gender and race in their letter of support to reduce the potential for bias.

A second suggestion to improve fairness in the evaluation of post-doctoral candidates in STEM specifically is to change post-doctoral hiring protocol to include additional checks and balances. Presently, post-doctoral candidates are evaluated and hired by Principal Investigators (PIs) only, rather than by hiring committees composed of people with diverse perspectives and backgrounds. Including additional faculty members in the evaluation of post-doctorates, from colleagues to administrators, may help to expose and/or undermine the operation of biases that an individual PI might have.

A third suggestion for STEM professors and those who hire STEM professionals is to develop anti-bias interventions that are tailored to address issues specific to Women of Color (Pietri et al. 2017). Although a number of trainings on bias awareness and intervention exist (e.g., United States Executive Office of the President/Office of Personnel Management/Office of Science and Technology Policy, 2016) these tend to address single forms of bias, such as sexism or racism. However, our study suggests that Latina and Black women are at a greater disadvantage in physics than all other candidates, and special attention should be paid in future interventions to counteracting this unique and intersecting form of disadvantage. A final suggestion for STEM professionals is to use clear and objective criteria for evaluating STEM job applicants. Because stereotypes alter the weight and attention we assign given aspects of a candidate's accomplishments (Norton et al. 2004), having consistent standards for the value of various accomplishments, as well as easy ways to compare accomplishments across candidates, may decrease the activation of stereotypes.

Conclusions

The current research provides novel and generalizable knowledge about stereotypes thwarting women's and minorities' advancement in STEM fields. The fair evaluation and hiring of postdoctoral racial minority and women candidates is likely to increase the representation and success of these groups in STEM. Our results indicate that future research should examine reasons for the differential expression of biases between STEM fields such as biology and physics, as well as the ramifications of violations of descriptive versus prescriptive norms. In terms of practice, masking the gender and race of candidates and implementing programs designed to decrease bias against Women of Color in STEM are warranted. Lastly, our findings highlight the importance of checks and balances in the hiring process, as well as the need to establish clear, objective evaluation criteria of postdoctoral candidates.

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Compliance with Ethical Standards

Conflict of Interest Asia A. Eaton declares no conflict of interest. Jessica F. Saunders declares no conflict of interest. Ryan K. Jacobson declares no conflict of interest. Keon West declares no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Written informed consent was obtained from all individual participants included in the study.

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CURRICULUM VITAE (Version 1)

Candidate Name

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University of North Texas

Education

2005-2015	Ph.D. Biology, 2015 (December), University of North Texas, Denton, TX.
2001-2005	B.S. Ecology and Evolutionary Biology, 2005 (May), Massachusetts Institute of Technology.

Honors

2015	Outstanding Dissertation Award, University of North Texas, 2015
2014	Dissertation Fellowship Award, University of North Texas, 2014.
2013	Graduate Student Research Competition, 1st Place, University of North Texas, 2013.
2005	Academic Excellence Award, Massachusetts Institute of Technology, 2005.

Grants and Awards

2015	Botanical Society of America (BSA) Annual Meeting 2015 Section Travel Award, $500, Fall 2015.
2014	UNT Dissertation Year Fellowship, $25,000, Fall 2014.
2014	NSF Graduate Research Fellowship Program, not awarded, Fall 2014.
2011	UNT Biology Scholarship, $2,500, Spring 2011.
2011	Pearce Scholarship, UNT, $2,000, Spring 2011.
2010	Judith Evans Parker Travel Scholarship, UNT, $1,100, Spring 2010.
2010	UNT Academic Scholarship, $1,000, Fall 2010.

Professional Experience

UNT, Department of Biological Sciences, Teaching Assistant: General Biology II Lab, 08/2013 – 08/2014; Evolution, 05/2013-08/2013; Ecology, 05/2011 – 08/2011; General Biology I Lab, 08/2008- 05/2010; Plant Ecology, 01/2009 - 05/2009.

UNT, Department of Biological Sciences, Online Teaching Assistant: General Biology I & II, 01/2013- 06/2013; Human Biology, 08/2012- 12/2012.

UNT, Department of Biological Sciences, Guest Lecturer: Ecology, 10/2011.

Professional Memberships

Botanical Society of America
Society for Economic Botany

Association for Tropical Biology and Conservation

Selected Publications

Wang, L. and Hall, D. 2015. New findings on the pollination biology of *Ruellia succulenta* in Buenos Aires, Argentina: Linking dioecy, wind, and habitat. American Journal of Botany 100(3): 613-621.

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Wang, L. Hall, D. Reconsidering wind-pollination in the tropics: a case study of Ruellia succulenta. UNT Biology Symposium, Denton, TX; 02/2015.

Wang, L., Hall, D. Moreno, R. Floral biology and pollination of the agroforestry palm, Ruela succulenta: Why field observations are not enough. Botanical Society of America Conference, Columbus, OH, 07/2014.

Wang, L. Phenology and population dynamics of Ruellia succulenta in Buenos Aires, Argentina. Plant Biologists of South Florida Annual Meeting, Miami, FL, 04/2014.

Wang, L. Phenology and population dynamics of Ruellia succulenta in Buenos Aires, Argentina. UNT Biology Symposium, Denton, TX, 01/2014. 1st place, Best Graduate Student Talk.

Wang, L. The reproductive ecology of Buriti in Buenos AireM. Federal University of Buenos Aires (FUBA), Buenos Aires, Argentina, 03/2012.

Wang, L. Hall, D. Poster presentation: The pollination biology of three sympatric palmM. Ecological Society of America’s Plant-Pollinator Interactions Conference, Milwaukee, WI, 08/2011.

Wang, L. The ecological grounding for fertile productivity in *Ruellia succulenta*: What role does environment play? Massachusetts Institute of Technology Undergraduate Research Symposium, Boston, MA, 07/2005.

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Candidate Name
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Education

2005-2015 Ph.D. Physics, 2015 (December), University of North Texas, Denton, TX.
2001-2005 B.S. Physics, 2005 (May), Massachusetts Institute of Technology.

Honors

2015 Outstanding Dissertation Award, University of North Texas, 2015.
2014 Dissertation Fellowship Award, University of North Texas, 2014.
2013 Graduate Student Research Competition, 1st Place, University of North Texas, 2013.
2005 Academic Excellence Award, Massachusetts Institute of Technology, 2005.

Grants and Awards

2015 American Physical Society (APS) Annual Meeting 2015, Section Travel Award, $500, Fall 2015.
2014 UNT Dissertation Year Fellowship, $25,000, Fall 2014.
2014 NSF Graduate Research Fellowship Program, not awarded, Fall 2014.
2011 UNT Physics Scholarship, $2,500, Spring 2011.
2011 Pearce Scholarship, UNT, $2,000, Spring 2011.
2010 Judith Evans Parker Travel Scholarship, UNT, $1,100, Spring 2010.
2010 UNT Academic Scholarship, $1,000, Fall 2010.

Professional Experience

UNT, Department of Physical Sciences, Teaching Assistant: General Physics II Lab, 08/2013 – 04/2014; Nuclear Physics, 05/2013-08/2013; Physics, 05/2011 – 08/2011; General Physics I Lab, 08/2008- 05/2010; Physics, 01/2009 - 05/2009.
UNT, Department of Physical Sciences, Online Teaching Assistant: General Physics I & II, 01/2013- 06/2013; 08/2012- 12/2012.
UNT, Department of Physical Sciences, Guest Lecturer: Nuclear Physics 10/2011.

Professional Memberships

Member of American Physical Society
APS Division of Nuclear Physics
Member of CLAS collaboration

Selected Publications

L. Wang, D. Hall, M. Maret, M. Wong, and CLAS Collaboration. Measurement of the Induced Λ(1116) polarization in K+ electroproduction at CLAM. Submitted to AIP Conference Proceeding. Proceedings of CIPANP 2015 Twelfth Conference on the Intersections of Particle and Nuclear Physics, Vail, CO, 2015.
L. Wang, D. Hall, M. Maret, K. Ching, and CLAS Collaboration. Measurement of the Induced Λ(1116) polarization in K+ electroproduction at CLAM. AIP Conference Proceeding M. Proceedings of NSTAR2011 - The 8th International Workshop on the Physics of Excited Nucleons, Newport News, VA, 2014.
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Near-threshold Photoproduction of Phi Mesons from Deuterium. CLAS Collaboration, PhyM.Lett.B696:338-342, 2014.
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Presentations and Posters

L. Wang, D. Hall, A. Wong, K. Goessling and CLAS Collaboration, “Measurement of the Induced Λ (1116) polarization in K+ electroproduction at CLAS”. Presented Twelfth Conference on the Intersections of Particle and Nuclear Physics (CIPANP), Vail, CO, May 2015.

L. Wang, D. Hall, A. Wong, K. Goessling and CLAS Collaboration, “Measurement of the Induced Λ (1116) polarization in K+ electroproduction at CLAS”. The 8th International Workshop on the Physics of Excited Nucleons, Newport News, VA, April 2014.

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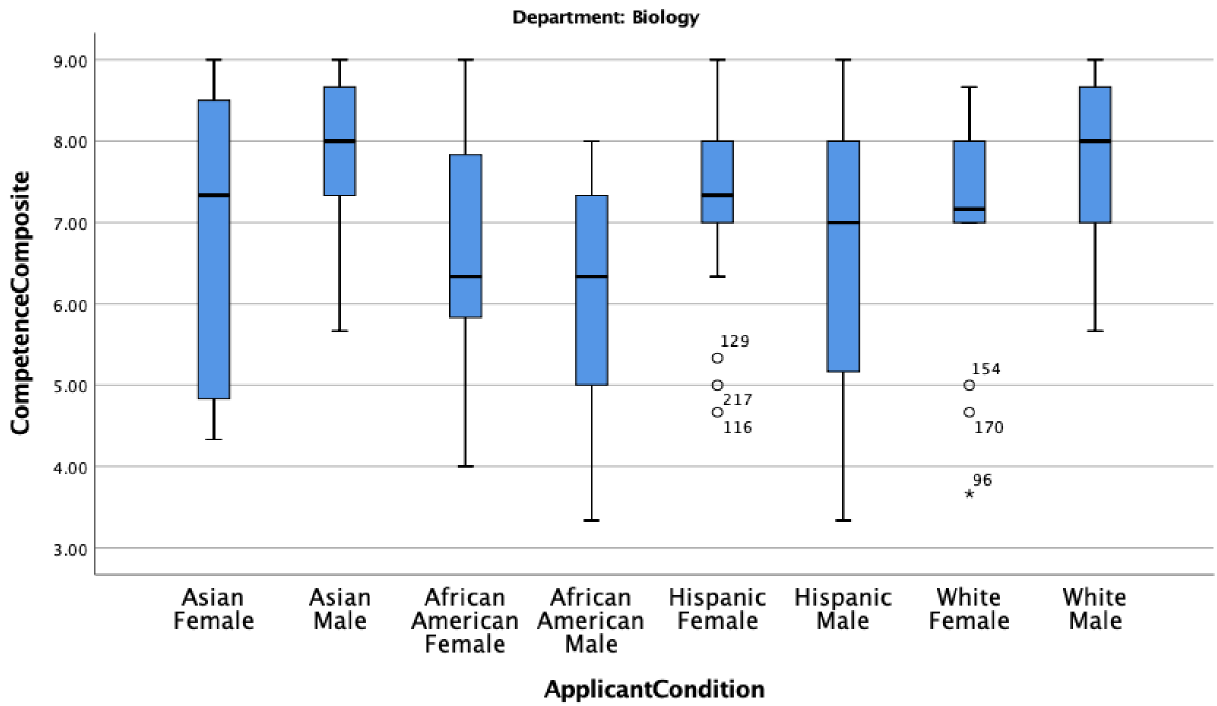

Figure 1. Boxplot illustrating distribution of Biology faculty competence ratings

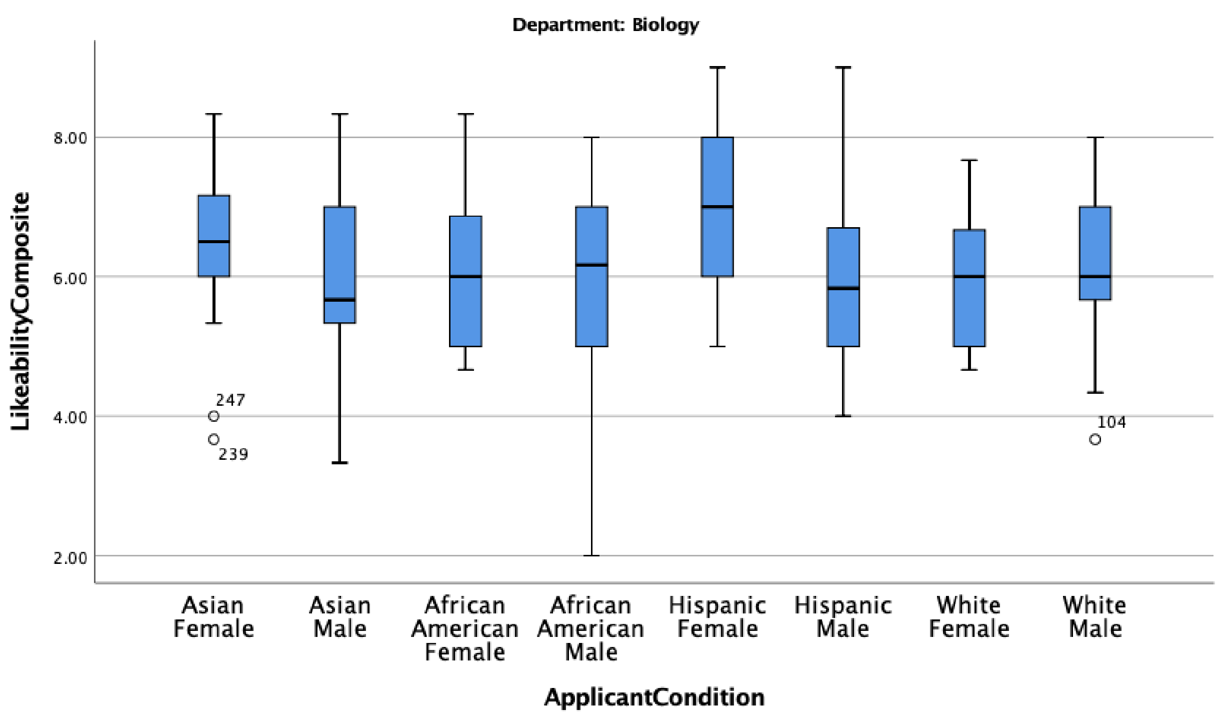

Figure 2. Boxplot illustrating distribution of Biology faculty likeability ratings

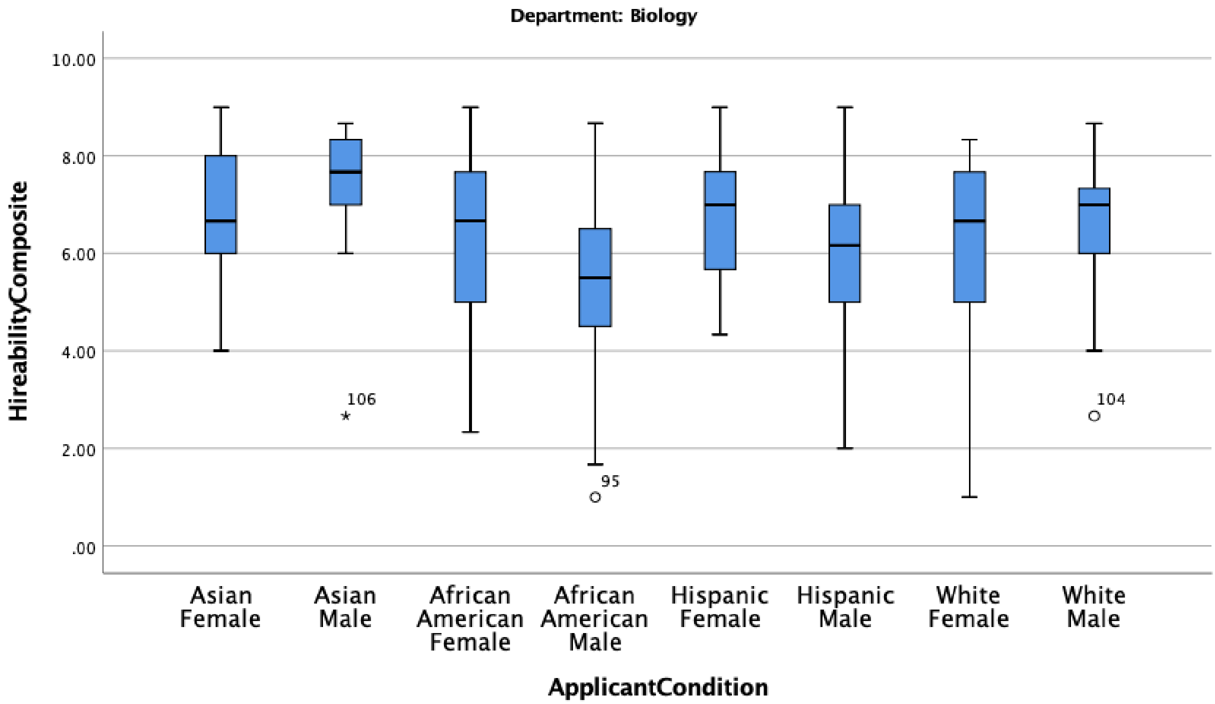

Figure 3. Boxplot illustrating distribution of Biology faculty hireability ratings

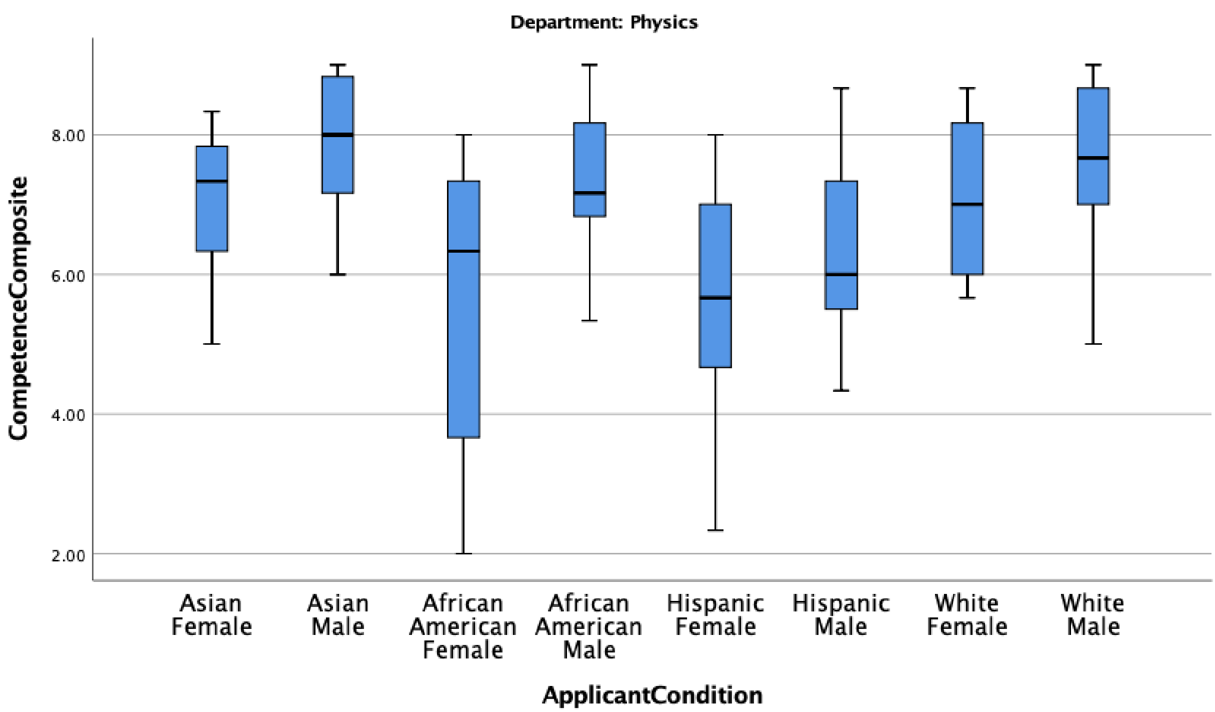

Figure 4. Boxplot illustrating distribution of Physics faculty competence ratings

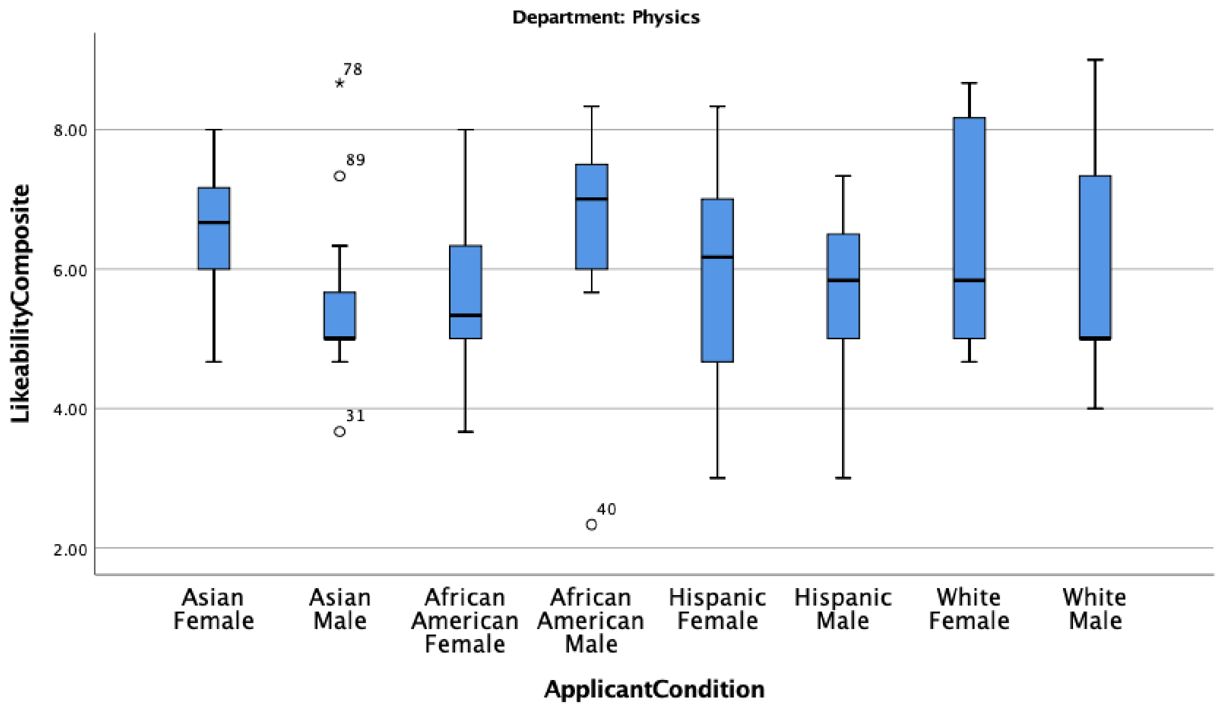

Figure 5. Boxplot illustrating distribution of Physics faculty likeability ratings

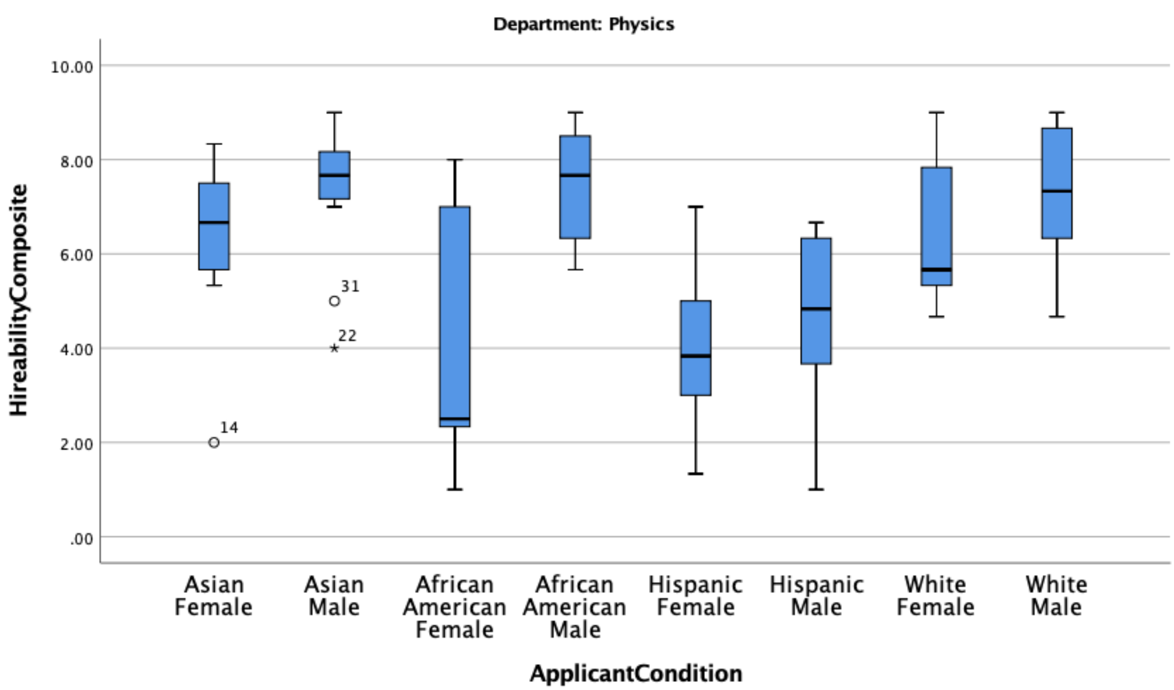

Figure 6. Boxplot illustrating distribution of Physics faculty hireability ratings

Table 1s

Mean ratings for each candidate by department

Biology Ratings

	Likeability	**Competence**	**Hireability**
	M (SD)	***M (SD)***	***M (SD)***
Asian Female	6.42 (1.19)$_{a,b}$	6.73 (1.72)$_{a}$	6.90 (1.37)$_{a,d}$
Asian Male	5.86 (1.38)$_{a}$	7.75 (1.08)$_{b,c,d}$	7.43 (1.45)$_{a}$
Black Female	6.15 (1.19)$_{a,b}$	6.60 (1.49)$_{a}$	6.28 (1.87)$_{a,d}$
Black Male	5.63 (1.84)$_{a}$	6.18 (1.38)$_{a}$	5.28 (2.09)$_{b,d}$
Latinx Female	6.90 (1.19)$_{b}$	7.27 (1.19)$_{a,b,d}$	6.75 (1.14)$_{a,c}$
Latinx Male	6.07 (1.39)$_{a}$	6.64 (1.38)$_{a}$	5.82 (1.91)$_{b,c}$
White Female	6.07 (.90)$_{a}$	7.00 (1.29)$_{a,b}$	6.26 (1.82)$_{d}$
White Male	6.02 (1.11)$_{a}$	7.80 (1.03)$_{c,d}$	6.57 (1.60)$_{a,d}$

Physics Ratings

	Likeability	**Competence**	**Hireability**
	M (SD)	***M (SD)***	***M (SD)***
Asian Female	6.55 (1.05) $_{a}$	6.97 (1.18) $_{a, d}$	6.42 (1.80)$_{a}$
Asian Male	5.52 (1.40) $_{a}$	7.88 (1.10) $_{b}$	7.30 (1.52)$_{a}$
Black Female	5.64 (1.12) $_{a}$	5.60 (2.12) $_{a}$	4.29 (2.61)$_{b}$
Black Male	6.46 (1.85) $_{a}$	7.33 (1.13) $_{c,a}$	7.46 (1.25)$_{a}$
Latinx Female	5.90 (1.56) $_{a}$	5.53 (1.72) $_{a}$	3.87 (1.83)$_{b}$
Latinx Male	5.62 (1.35) $_{a}$	6.33 (1.38) $_{a,e}$	4.67 (1.94)$_{b}$
White Female	6.39 (1.54) $_{a}$	7.11 (1.13) $_{b,c,d,e}$	6.28 (1.48)$_{a}$
White Male	5.80 (1.45) $_{a}$	7.68 (1.05)$_{b,c,d}$	7.35 (1.40)$_{a}$

Note. Means in the same row that do not share a subscript differ at $p < .05$.