EQUAL OPPORTUNITIES IN ACADEMIC RESEARCH DEVELOPMENT? FACULTY GENDER BIAS AND STEREOTYPES IN RESEARCH ADMINISTRATION

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ABSTRACT

Female faculty remain a minority in academic research and women are often perceived to lack the qualities needed to be successful scientists, which may contribute to discrimination and prejudice against female researchers. Research administrators play a pivotal role in the development of strategic, catalytic, and capacity-building activities designed to encourage faculty in attracting extramural research funding. The purpose of this investigation was to explore whether research administrators evaluate extramural grant applicants differently based on gender and different career ranks. Contrary to previous research examining faculty gender biases and stereotypes, our study showed that applicants were rated similarly in researcher competence across both male and female applicants by research administrators (Hypothesis 1). Our research also showed that female candidates were generally seen as more likeable (researcher collegiality) and were rated higher for mentoring potential than male candidates (Hypothesis 2). Furthermore, consistent with prior research, findings suggest that those in the senior career rank were more highly rated for research competence and skill (Hypothesis 3). Although we did not list a formal hypothesis, our findings did support the notion that senior career rank applicants are more highly rated for biosketch design and comprehension, most likely due to their perceived competence and advanced experience. These findings, while preliminary, suggest that traditional barriers related to perceived female researcher competence are not experienced as they interact with research administrators. The main implication of this study is that research administrators do not appear to significantly contribute to the previously reported discrimination and prejudice against the competence of female researchers.

Keywords:

gender bias; academic researchers; faculty productivity; research administrators; female faculty; gender disparities; academic stereotypes

INTRODUCTION

The percentage of women in academic science has increased dramatically during the past several decades (Abelson et al., 2016). Despite this success, female faculty remain a minority in academic research (Krebs et al., 2020). Issues surrounding gender bias and stereotypes have been addressed over the past 45 years with various pieces of legislation, federal policies, and published literature with mixed results (Easterly & Ricard, 2011). Prior research has demonstrated that female researchers suffer when their extramural proposals are judged primarily on the strength of their curriculum vitae or biosketch (Eaton et al., 2020; Guglielmi, 2018; Tamblyn et al., 2018; Witteman et al., 2019). Women are often perceived to lack the qualities needed to be successful scientists, which may contribute to discrimination and prejudice against female researchers (Carli et al., 2016).

The mechanisms that underpin gender bias and stereotypes in academic research are not fully understood. One unexplored area is the impact research administrators may have on gender bias and stereotypes in academic research. Research administrators play a pivotal role in the development of strategic, catalytic, and capacity-building activities designed to encourage faculty in attracting extramural research funding (Ross, 2017). The purpose of this investigation was to explore whether research administrators evaluate applicants differently based on gender at multiple career ranks. Our goal was to contribute to a deeper understanding of the barriers for female researchers as they interact with research administrators.

BACKGROUND

Underrepresentation of Women in Science

A stark gender disparity persists within academic science (Chan & Torgler, 2020; Handley et al., 2015; Jena et al., 2016; Moss-Racusin et al., 2012; Reuben et al., 2014; Roper, 2019), including large gender gaps in female faculty representation in research (Abelson et al., 2016; Krebs et al., 2020). Although women represent 50.8% of the current United States population, men have represented the majority of basic science faculty at all ranks for the last 20 years (Bennett et al., 2020). Over the last two decades, female basic science faculty were also consistently underrepresented (24.47% to 35.32%) in United States medical schools (Bennett et al., 2020). It has been shown that fewer women than men embark on a scientific career, and proportionally more women than men drop out of science majors in college. Furthermore, those women who do persevere and obtain scientific graduate degrees often do not achieve academic success along the lines of their male counterparts (Bar-Haïm & Wilkes, 1989).

Effective mentorship is the most critical element to the development of a successful career in academic research (Cochran et al., 2019). Lack of resources and information about how to secure resources were among the most frequently cited academic systemic barriers for female researchers (Cochran et al., 2019). Results suggest that female researchers may have to accumulate more scientific knowledge, resources, and social capital to achieve the same level of productivity and total outputs as their male counterparts (Aguinis et al., 2018). Findings from one study show gender was significantly associated with the number of publications, with female researchers being more likely to have no publications in the last three years versus male researchers (Elkbuli et al., 2020). However, results from that same study also showed that among those with protected research time, there was no significant difference in the number of publications in the last three years based on gender, suggesting that protected research time has the potential

to address gaps in research productivity that may exist (Elkbuli et al., 2020). Reasons why gender differences in protected research time prevail are still unknown but are the topic of ongoing research.

Bias in Academic Research and Research Administration

Research administrators play a vital role in facilitating a supportive research environment and making available the funding for conducting research (Mullen, 2009). Female researchers frequently experience professional and social isolation in their early years, which can have a lasting negative effect on their research development and academic promotion (Davis, 2008; Easterly, 2008; Lowenstein, 2006; Mullen, 2008, 2009). Feminist scholars have outlined the importance of informal mentoring in adult learning and development (Mullen, 2009). Research administrators have a unique opportunity and obligation to elevate the creativity, motivation, and productivity of underrepresented researchers through intentional mentorship (Mullen, 2009). Previous research highlights the link between a research administrator's knowledge of scientists' needs with the ability to help them achieve the academic goals of a successful research program (Easterly & Ricard, 2011; Pogatshnik, 2008; Robinson, 2008). Many solutions have been proposed to reduce gender bias in research, including the use of initials for the first name to mask gender in letters of support and curricula vitae when materials are reviewed for tenure, promotion, or other advancement opportunities (Easterly & Ricard, 2011). However, far too little attention has been paid to reducing bias within local research administration and research support staff.

Theoretical Foundation

Overall, studies on female academic productivity are consistent with the stereotype content model, role-congruity, and lack-of-fit theories. These theories often report incompatibility of female gender stereotypes with stereotypes about high-status occupational roles. These studies demonstrate that women are perceived to lack the qualities needed to be successful researchers, which may contribute to discrimination and prejudice against female researchers (Carli et al., 2016). Role congruity theory proposes that the greater the overlap between a person's perceived characteristics (i.e., skills, traits, behaviors) and their job role, the greater the perceived competence in that role. The concern is that incongruity can result in prejudice (Eagly & Karau, 2002). The stereotype content model asserts that status predicts competence, and competition predicts low warmth or envy (Fiske et al., 2002). Whereas the lack-of-fit model is grounded on the premise that gender stereotypes dominate in the workplace, shaping the ways applicants and employees are perceived (Heilman & Caleo, 2018). Together, these theories provide a firm foundation for the proposed study.

Study Significance

Previous studies have shown that female academics suffer when their research is judged primarily on the strength of their biosketch (Eaton et al., 2020; Guglielmi, 2018; Tamblyn et al., 2018; Witteman et al., 2019). However, the effects of gender bias and stereotypes from research administration on female researchers' productivity have not been closely examined. Research administration is a predominately female-dominated profession, with over 80% of the profession being women worldwide and 83.5% being women in the United States (Kerridge & Scott, 2018). Central to the entire discipline of research administration is the pivotal role in the development of strategic, catalytic, and capacity-building activities designed to encourage academic researchers in attracting extramural

funding. The significance of the proposed research is to shed light on the role research administrators might play in the judgment, treatment, and productivity of female researchers. This research will contribute to the larger body of knowledge on the gender gap in academic research. To the extent that research administrators see individuals of a certain gender as more or less competent, they may be more or less likely to assist and mentor such individuals. Because stereotypes alter the weight and attention research administrators may assign given aspects of an applicant's accomplishments (Norton et al., 2004), having consistent standards for the value of various accomplishments and easy ways to compare accomplishments across applicants may decrease the activation of stereotypes. Biases in research administration could lead to a disproportionately low representation of women in research due to a lack of support and mentorship, reinforcing the perception that they are not appropriate for or successful in academic positions. Interventions may be needed to ensure women are fairly evaluated and consistently engaged by research administrators at the postdoctoral level and beyond.

Rationale

Many researchers have utilized grant applications, curricula vitaes, conference abstracts, and grading rubrics to quantify and assess gender differences in academia. Several studies have shown a significant association between gender and peer-review grant application scores, with lower scores associated with female applicants (Guglielmi, 2018; Roper, 2020; Tamblyn et al., 2018; Witteman et al., 2019). When it comes to reviewing curricula vitaes in the academic sciences, studies by Moss-Rascusin et al. (2012) and Eaton et al. (2020) showed that participants rated a male applicant as significantly more competent and offered more career mentoring than the identical female applicant (Eaton et al., 2020; Moss-Racusin et al., 2012). Results of these studies are significant in that faculty were less inclined to mentor female than male researchers, raising the possibility that female faculty may drop out of academic science careers in part because of reduced competence judgments, rewards, and mentoring received in their early career (Eaton et al., 2020; Moss-Racusin et al., 2012). In a similar study, faculty in physics showed a gender bias favoring the male candidates as more competent and more hirable than the otherwise identical female candidates (Eaton et al., 2020). Knobloch-Westerwick et al. (2013) and Myers et al. (2020) reported that conference abstracts from male authors were associated with greater scientific quality, and that collaboration interest was highest for male authors working on male-typed topics (Knobloch-Westerwick et al., 2013; Myers et al., 2020). Similarly, Jackson (2016) found that the use of a grading rubric amplified the effect of implicit gender bias from participants in strongly-gender normative concepts, such as an implicit association of men with science (high implicit bias).

The Current Study

The proposed study will utilize biosketches to assess whether research administrators evaluate applicants differently due to biased assessments based on gender for each career rank (student, resident, junior faculty, or senior faculty), as outlined by Moss-Rascusin et al. (2012) and Eaton et al. (2020). One advantage of the biosketch approach is that it avoids the issue of creating either an unambiguously strong or an intentionally weak curriculum vitae, which might act as bias amplifiers (Eaton et al., 2020; Williams & Ceci, 2015). Due to its structure and widespread use, the biosketch acts as part curriculum vitae and part grading rubric for research administrators, allowing a more standard and even-measured approach at each level of training. In addition, this approach will allow for the collection of the participants' own social identities to assess the potential impact of the expression of gender bias and

stereotypes, including the extent to which they share identities with an applicant, which previous studies have not yet addressed (Eaton et al., 2020).

Contrary to previous research examining academic gender biases, we predicted that female and male applicants, overall, would be rated similarly in competence given that our study surveyed a female-dominated research administrator workforce (Hypothesis 1). Based on research on descriptive stereotypes, we also predicted that female candidates would be seen as more likable (researcher collegiality) and would be rated higher for mentoring potential than male candidates, as these traits may be perceived as communal and more typical of women than men (Hypothesis 2). Furthermore, consistent with prior research, we predicted that those in the senior career rank applicants would be more highly rated for research competence and skill (Hypothesis 3). Although we did not have any other formal hypotheses, we also assessed biosketch design and comprehension, and expected that senior career rank applicants would likely be more highly rated for biosketch design and comprehension due to competence in the field.

METHODS

Study Objectives

The primary purpose of the current study was to examine how applicant's gender influences perceptions of research administrators who evaluate those applicants for extramural research funding applications. Specifically, we examined research administrator's perceptions of researcher competence, grant fundability, salary conferral, mentoring potential, and researcher likeability across four levels of academic training, based on the candidate's gender. We modeled our study after two landmark studies on job discrimination in the evaluation of curriculum vitae and resumes (Eaton et al., 2020; Moss-Racusin et al., 2012), in which the applicant name on a single resume or curriculum vitae was varied while all else was held constant.

Based on the stereotype content model (Fiske et al., 2002), as well as previous research examining scientist gender biases in academia (Eaton et al., 2020; Moss-Racusin et al., 2012), male applicants are typically rated as higher in competence and fundability than female applicants across all levels of training. However, we predicted that this difference would not be as significant in this population as previously reported in the literature since research administration is a predominately female-dominated profession. Furthermore, we also predicted that junior levels of training would have significantly more bias as research administrators might interpret experience as an equalizer at senior levels.

Study Type and Design

This quantitative causal/experimental research applied the stereotype content model and theories of role-congruity and lack-of-fit that relate the gender bias construct to variables of researcher competency in pre-award research administrators. The independent variables were defined as applicant gender and applicant career rank. The dependent variable(s) were defined as researcher competence, grant fundability, salary conferral, mentoring potential, and researcher likeability. Participant gender and participant age were considered as potential covariates.

Population and Sample

A total of 310 emails were sent on Wednesday, June 16, 2021, at 07:15 AM Central to current Society of Research Administrators International (SRAI) members. Emails were also distributed via the International Network of Research Management Societies (INORMS) to up to twenty different professional societies during the week of June 21, 2021, representing

up to 50,000 individuals. Finally, a total of 290 reminder emails were sent on Monday, July 12, 2021, at 01:00 PM Central to current SRAI members who had not yet completed the survey.

Subjects included research administrators who 1) have an active membership in one of the twenty INORMS member associations, and 3) self-identify with at least one of the stated areas of expertise, including clinical and translational research, grant writing and proposal development, leadership, and professional development, pre-award administration, research development, and/or research support operations. Participants were provided with the principal investigator's contact information and were encouraged to contact the study team if at any time they wish to withdraw from the study.

Research administrators were excluded if they did not have an active INORMS member association membership or self-identified with expertise exclusively outside the included areas of expertise. The following areas of expertise were not accepted: administration management, departmental administration, executive or senior leadership, financial management, human resources, legal issues, management and operations, post-award, research contracts and law, research ethics/integrity/compliance, or technology development/transfer as these areas typically do not work with academic researchers in submitting extramural grant applications. As the study survey was provided in English, non-English speakers were excluded from the study. Those participants who do not complete the entire survey were excluded from the final data analysis (n=65).

Creation of Biosketches

Previous literature suggests that stereotypes are most likely to be expressed in the assessment of ambiguous or average targets (Moss-Racusin et al., 2012), which allow room for several interpretations. For this reason, the biosketches in the current study were created to represent applicants whose qualifications were average overall. First, we solicited sample biosketch content from surgical students, residents, junior faculty, and senior faculty (four career ranks) for use in content creation. These individuals were unaware of our study's hypotheses, and they were told the research team needed assistance in creating average biosketches for general research study. Similar to previous work (Eaton et al., 2020), the basis of the surgical biosketches came from real-life researchers, including real journal titles, national professional associations, and national conferences. Together, this content was used to draft a biosketch at each of the four career ranks.

The applicant names were selected among the most common first and last names indicated in the 2020 Social Security Administration. The names were Bradley Miller (the male condition) and Claire Miller (the female condition). These names were pretested and validated in a similar recent publication (Eaton et al., 2020). The biosketches differed across each of the four career ranks (to reflect the given level) but were identical across candidate gender at each level, with the exception of the candidate's first name (Table 1).

Table 1: Creation of Biosketches

Career Level	Gender Condition (Only First Name Changed)
Student Biosketch	Bradley Miller Claire Miller
Trainee Biosketch	Bradley Miller Claire Miller
Junior Faculty Biosketch	Bradley Miller Claire Miller
Senior Faculty Biosketch	Bradley Miller Claire Miller

Analysis

Simple descriptive statistics were tabulated for all variables, including participant demographic and career characteristics and responses to all survey questions. Associations between applicant gender (female vs. male) or career rank (student, resident, junior faculty, or senior faculty) and each dependent variable were estimated using cumulative link mixed models with Laplace approximation for Likert scale outcomes or linear mixed-effects models for continuous outcomes, with participant included as a random effect to account for clustered survey responses for each biosketch pair. Career rank exhibited a monotonic dose-response relationship with Likert score; thus, career rank was modeled as an ordinal predictor. Multivariate models including both applicant gender and career rank as main effects with an interaction term between applicant gender and career rank were estimated. Some regression models could not be estimated due to challenges with model estimation and performance given the small number of participants and unbalanced strata for predictors (i.e., models failed to converge or did not have a positive definite variance matrix). For those associations, dependent sample Sign Tests (for Likert scale outcomes) or Wilcoxon Signed Rank Tests (for continuous outcomes) were used to compare the paired survey responses. Other proposed covariates, including participant gender and age, were not included in statistical models due to small sample size constraints. Statistical significance for all analyses was defined as $p<0.05$, and analyses were performed using R, version 3.6.1.

Ethical Considerations for a Deception Study

Before completing this survey, participants were told that the purpose of the study was to (a) determine how well research administrators can assess career academics based on small amounts of information and (b) compare standards for extramural funding success at different universities. However, the study's actual purpose was to explore whether research administrators treat clinician applicants differently due to their gender at differing career ranks. Participants in the study were given, at random, the same biosketch with differing gender-specific names.

The research team intentionally withheld information regarding the study's true purpose from participants to help reduce demand characteristics and socially desirable responses. Demand characteristics are a subtle cue that makes participants aware of the true purpose of the study, or how participants are expected to behave. Demand characteristics could change the outcome of an experiment because participants will often alter their behavior to conform to expectations.

Our study design was modeled from two previous studies, Eaton et al. (2020) and Moss-Racusin et al. (2012), which used a cover story as a deception technique. No harm or reactions from participants to the use of deception was reported in either of these studies. Moreover, there was no indication that the deception would result in an increased risk to our participants. There were no reasonably effective, alternative methods available to achieve the goals of the research. The research question and limited population did not permit a double-blind study method. Any hint or cue related to gender or stereotype bias would have profoundly influenced how the participants responded to the survey. Knowing the true purpose of the study might have motivated participants to act in ways that they think are socially desirable (to make themselves look "better") or in ways that are antagonistic to the study (an attempt to throw off the results or ruin the experiment.)

At the completion of data collection, all participants were emailed a study debriefing form that indicated the study's true purpose. After learning the true purpose of the

research study, participants were given the opportunity to have their data removed from the study. No participants elected to have their data removed from the study. Participants were asked to keep the details of this study confidential until three months after the planned project end date when all data collection was completed.

As a part of our cover story, we asked participants to evaluate how research administrators perceive the formatting and content of postdoctoral biosketches. To support our cover story, four questions on the format of the biosketch were included at the beginning of the survey before participants assess the applicant's competence, likeability, and competitiveness. According to the cover story, the potential benefit of participating in the study for the individual, the greater population, and science, society, and humanity, in general, includes helping to inform cutting-edge academic research regarding biosketch formatting and content for academics. The true nature of the study provides an even more significant benefit by informing academic research regarding how an applicant's gender influences the perceptions of research administrators who evaluate those applicants for extramural research funding applications.

Results

A total of 35 participants completed the survey and were included in the analysis. The majority of participants were female (82.9%) and living in the United States (91.4%). Small, medium, and large institutions (<10,000; 10,000-25,000; >25,000 students or employees) were approximately evenly represented across participants, and over half of the participants reported feeling at least somewhat qualified to evaluate a biosketch (Table 2). The majority of participants reported expertise related to pre-award (77.1%), grant-writing and proposal development (60.0%), and research development (57.1%), though all expertise categories were represented in the participant group.

Table 2: Demographic and Career Characteristics for All Participants

	All participants (N=35)
Sex	
Female	29 (82.9%)
Male	6 (17.1%)
Residence	
Africa	1 (2.9%)
Asia	1 (2.9%)
Europe	1 (2.9%)
United States	32 (91.4%)
Institution Size	
Small (Less than 10,000 students/employees)	10 (28.6%)
Medium (10,000 to 25,000 students/employees)	10 (28.6%)
Large (More than 25,000 students/employees)	15 (42.9%)
How qualified do you feel to evaluate a biosketch?	
Not at all Qualified	2 (5.7%)
Slightly Qualified	6 (17.1%)
Somewhat Qualified	9 (25.7%)
Moderately Qualified	13 (37.1%)
Extremely Qualified	5 (14.3%)

Overall, participants rated the biosketches favorably, with the median responses for all questions scored as 3 or higher (Table 3). Each participant reviewed two biosketches, and the average difference in the Likert response between biosketches was less than 1 for all questions, suggesting that participants tended to respond similarly to each biosketch as a group. However, univariate mixed effects models predicting survey response by applicant gender or career rank while controlling for correlated participant responses revealed that both predictors (gender and career rank) were significantly associated with more favorable responses to survey questions in all categories. These included biosketch design and comprehension, researcher competence and skill, grant fundability, researcher collegiality, mentoring potential, and salary and competitiveness (Table 4). Most univariate associations held after adjustment for the other predictor. In multivariate models including both applicant gender and career rank, female gender was more strongly associated with higher responses on questions relating to researcher collegiality and mentoring potential, while more senior career rank tended to more strongly predict favorable responses for biosketch design and comprehension, research competence and skill.

Table 3: Survey Response Descriptive Statistics for All Participants

	Median (Min, Max)	Mean (SD)	Mean difference*
Researcher competence			
How easy was it for you to navigate the biosketch?	5.00 [2.00, 5.00]	4.44 (0.845)	0.0857 (0.853)
How complete or comprehensive was the information in the biosketch?	4.00 [1.00, 5.00]	3.74 (1.11)	0.171 (1.42)
How professional was the biosketch?	4.00 [1.00, 5.00]	4.01 (1.06)	-0.0286 (1.36)
How well-written was the biosketch?	4.00 [2.00, 5.00]	3.86 (1.07)	0.114 (1.32)
Based on the biosketch you read, did the applicant strike you as competent?	4.00 [1.00, 5.00]	4.10 (0.995)	0.371 (1.55)
How likely is it that the applicant has the necessary skills for the research project?	4.00 [1.00, 5.00]	3.80 (1.11)	0.514 (1.69)
How qualified do you think the applicant is?	4.00 [1.00, 5.00]	3.91 (1.02)	0.400 (1.59)
Grant fundability			
How likely would you be to encourage the applicant to submit an NIH grant, assuming it is appropriate for their level of training and experience?	4.00 [2.00, 5.00]	3.93 (1.04)	0.429 (1.52)
How likely do you think it would be for the applicant to make the "first cut" (be in the top tier of applicants) if they applied for an NIH grant?	3.00 [1.00, 5.00]	3.30 (1.09)	0.429 (1.60)
How likely do you think it would be for the applicant to be awarded an NIH grant award?	3.00 [1.00, 5.00]	3.10 (1.11)	0.486 (1.52)
Researcher likeability			
Based on the biosketch you read, how much did you like the applicant?	4.00 [1.00, 5.00]	3.73 (0.947)	0.543 (1.31)
Would you characterize the applicant as someone you want to get to know better?	4.00 [1.00, 5.00]	3.63 (0.951)	0.457 (1.22)
Would the applicant fit in well with other faculty members at your institution?	4.00 [1.00, 5.00]	3.67 (1.05)	0.429 (1.44)
Mentoring potential			
How likely would you be to encourage the applicant to stay in the field if he/she was considering changing research topics?	4.00 [2.00, 5.00]	3.76 (0.842)	0.600 (0.775)
How likely would you be to encourage the applicant to continue to focus on research if he/she was considering switching focus away from research?	4.00 [2.00, 5.00]	3.81 (0.767)	0.314 (0.718)
How likely would you be to give the applicant extra help if he/she was having trouble mastering a difficult research concept?	4.00 [2.00, 5.00]	4.16 (0.828)	0.0857 (0.658)
How competitive overall is the candidate?	4.00 [1.00, 5.00]	3.64 (1.14)	0.371 (1.54)
How competitive is their honors record?	4.00 [1.00, 5.00]	3.49 (1.28)	-0.114 (1.92)
How competitive is their grants and awards record?	3.00 [1.00, 5.00]	2.71 (1.49)	0.171 (2.42)

	Median (Min, Max)	Mean (SD)	Mean difference*
How competitive is their professional experience record?	4.00 [1.00, 5.00]	3.49 (1.30)	-0.171 (2.08)
How competitive is their publication record?	3.00 [1.00, 5.00]	2.97 (1.41)	0.286 (2.05)
How competitive is their presentations and posters record?	3.00 [1.00, 5.00]	2.50 (1.33)	0.314 (1.76)
Salary conferral			
Please indicate the starting salary you would recommend for the applicant at an institution like yours (in UNITED STATES dollars).	$120000 [0, $350000]	$129000 ($83800)	Mean: $1790 (128000) Median: $0 [-285000, 350000]
Compared to the average applicant for a position at an institution like mine, the applicant I just read about would rank in the top __% for overall excellence (with lower numbers indicating a higher ranking).	25.0 [5.00, 80.0]	30.9 (20.8)	Mean: -1.00 (27.9) Median: 0 [-50.0, 50.0]

* mean difference in participant responses between the biosketch pairs.

Both gender and career rank were significantly associated with applicant grant fundability and salary and competitiveness questions. On average, participants recommended starting salaries that were $6,000 higher for female applicants (male salary = $136,000 (SD=79,800); female salary = $142,000 (SD=99,200)), with markedly different recommendations by career level (student = $88,600 (SD=49,900); resident = $87,300 (SD=48,500); junior faculty = $163,000 (SD=78,300); senior faculty = $215,000 (SD=96,100)).

Interaction models revealed statistically significant main and interaction effects between applicant gender and career rank for the question “How easy was it for you to navigate the biosketch?”. Specifically, female gender and higher career rank were both significantly associated with more favorable survey responses, while the joint effect of female gender and higher career rank was negatively associated with favorable response (main effects β (SE, p-value): gender = 0.40 (0.004, <0.0001); career rank = 0.15 (0.004, <0.0001); interaction = -0.05 (0.004, <0.0001)). No other interactions were statistically significant (results not shown). It is important to note that these models were underpowered due to small sample size.

Table 4: Univariate, Multivariate, and Interaction Models Estimating Associations Between Applicant Gender or Career Rank and Survey Responses

	Univariate model β (SE), p-value	Multivariate model β (SE), p-value
Design and Comprehension		
How easy was it for you to navigate the biosketch?		
Applicant Gender	0.26 (0.003), <0.0001	0.27 (0.58), 0.64
Applicant Level	0.13 (0.28), 0.65	0.13 (0.28), 0.65
Applicant Gender*Level		
How complete or comprehensive was the information in the biosketch?		
Applicant Gender	0.39 (0.46), 0.40	0.48 (0.47), 0.31
Applicant Level	0.60 (0.23), 0.01	0.62 (0.24), 0.009
Applicant Gender*Level		
How professional was the biosketch?		
Applicant Gender	-0.11 (0.46), 0.81	-0.08 (0.46), 0.87
Applicant Level	0.28 (0.22), 0.19	0.28 (0.22), 0.20
Applicant Gender*Level		
How well-written was the biosketch?		
Applicant Gender	0.20 (0.46), 0.67	0.22 (0.47), 0.64
Applicant Level	0.41 (0.24), 0.08	0.42 (0.24), 0.08
Applicant Gender*Level		
Researcher Competence and Skill		
Based on the biosketch you read, did the applicant strike you as competent?		
Applicant Gender	<0.0001a	--
Applicant Level	0.89 (0.22), <0.0001	--
Applicant Gender*Level		
How likely is it that the applicant has the necessary skills for the research project?		
Applicant Gender	0.86 (0.44), 0.052	0.98 (0.45), 0.03
Applicant Level	0.70 (0.22), 0.001	0.74 (0.22), 0.0009
Applicant Gender*Level		
How qualified do you think the applicant is?		
Applicant Gender	<0.0001a	--
Applicant Level	0.88 (0.23), 0.0001	--
Applicant Gender*Level		
Grant Fundability		
How likely would you be to encourage the applicant to submit an NIH grant, assuming it is appropriate for their level of training and experience?		
Applicant Gender	0.84 (0.001), <0.0001	1.08 (0.49), 0.03
Applicant Level	0.81 (0.24), 0.0007	0.90 (0.26), 0.0005
Applicant Gender*Level		

	Univariate model β (SE), p-value	Multivariate model β (SE), p-value
How likely do you think it would be for the applicant to make the "first cut" (be in the top tier of applicants) if they applied for an NIH grant?		
Applicant Gender	<0.0001a	0.75 (0.44), 0.09
Applicant Level	0.80 (0.22), 0.0003	0.81 (0.23), 0.0003
Applicant Gender*Level		
How likely do you think it would be for the applicant to be awarded an NIH grant award?		
Applicant Gender	<0.0001a	1.07 (0.48), 0.02
Applicant Level	0.94 (0.25), 0.0002	1.02 (0.27), 0.0001
Applicant Gender*Level		
Researcher Collegiality		
Based on the biosketch you read, how much did you like the applicant?		
Applicant Gender	1.14 (0.47), 0.02	1.14 (0.48), 0.02
Applicant Level	0.07 (0.20), 0.71	0.08 (0.21), 0.70
Applicant Gender*Level		
Would you characterize the applicant as someone you want to get to know better?		
Applicant Gender	0.97 (0.48), 0.04	1.01 (0.48), 0.04
Applicant Level	0.20 (0.23), 0.37	0.23 (0.23), 0.31
Applicant Gender*Level		
Would the applicant fit in well with other faculty members at your institution?		
Applicant Gender	0.81 (0.45), 0.07	0.86 (0.002), <0.001
Applicant Level	<0.0001a	0.44 (0.002), <0.001
Applicant Gender*Level		
Mentoring Potential		
How likely would you be to encourage the applicant to stay in the field if he/she was considering changing research topics?		
Applicant Gender	2.37 (0.69), 0.0006	2.46 (0.71), 0.0005
Applicant Level	0.15 (0.23), 0.52	0.27 (0.26), 0.30
Applicant Gender*Level		
How likely would you be to encourage the applicant to continue to focus on research if he/she was considering switching focus away from research?		
Applicant Gender	1.45 (0.60), 0.02	1.47 (0.65), 0.02
Applicant Level	0.04 (0.24), 0.89	0.08 (0.29), 0.79
Applicant Gender*Level		
How likely would you be to give the applicant extra help if he/she was having trouble mastering a difficult research concept?		
Applicant Gender	0.47 (0.57), 0.41	0.48 (0.58), 0.41
Applicant Level	0.14 (0.28), 0.62	0.14 (0.28), 0.62
Applicant Gender*Level		
Salary and Competitiveness		

	Univariate model β (SE), p-value	Multivariate model β (SE), p-value
How competitive overall is the candidate?		
Applicant Gender	0.84 (0.45), 0.06	0.94 (0.48), 0.05
Applicant Level	0.76 (0.23), 0.001	0.80 (0.24), 0.001
Applicant Gender*Level		
How competitive is their honors record?		
Applicant Gender	-0.15 (0.43), 0.72	-0.17 (0.44), 0.69
Applicant Level	0.83 (0.24), 0.0004	0.83 (0.24), 0.0004
Applicant Gender*Level		
How competitive is their grants and awards record?		
Applicant Gender	0.56a	0.29 (0.47), 0.54
Applicant Level	1.65 (0.35), <0.0001	1.65 (0.35), <0.0001
Applicant Gender*Level		
How competitive is their professional experience record?		
Applicant Gender	<0.0001a	-0.35 (0.48), 0.46
Applicant Level	1.71 (0.39), <0.0001	1.72 (0.39), <0.0001
Applicant Gender*Level		
How competitive is their publication record?		
Applicant Gender	0.005a	0.57 (0.48), 0.23
Applicant Level	1.17 (0.28), <0.0001	1.23 (0.30), <0.0001
Applicant Gender*Level		
How competitive is their presentations and posters record?		
Applicant Gender	0.49 (0.45), 0.27	0.52 (0.45), 0.25
Applicant Level	0.38 (0.21), 0.07	0.39 (0.21), 0.07
Applicant Gender*Level		
Please indicate the starting salary you would recommend for the applicant at an institution like yours (in UNITED STATES dollars).		
Applicant Gender	<0.0001b	--
Applicant Level	<0.0001b	--
Applicant Gender*Level	--	--
Compared to the average applicant for a position at an institution like mine, the applicant I just read about would rank in the top __% for overall excellence (with lower numbers indicating a higher ranking).		
Applicant Gender	<0.0001b	--
Applicant Level	<0.0001b	--
Applicant Gender*Level	--	--

ap-values estimated using dependent samples Sign Test
bp-values estimated using Wilcoxon Signed Rank Test

DISCUSSION

The percentage of women in academic science has increased dramatically during the past several decades, and yet a large gender gap remains. The proportion of graduating female medical students has increased on average 0.5% in the last decade, however female full professors still make up less than 10% of all full professors in academic medicine (Abelson et al., 2016). At the current rate, gender equivalence will not be reached until the year 2135. A similar storyline exists in female researcher success. Despite many years of work to diminish gender bias, female researchers often "disappear" after 10 years in academic research (Easterly & Ricard, 2011). While there has been a dramatic rise in female recipients of first-time NIH extramural funding over the last decade (Krebs et al., 2020), female researchers consistently have fewer publications, submit fewer grant applications, and request lower budgets than their male faculty counterparts (Krebs et al., 2020).

Women are often perceived to lack the qualities needed to be successful scientists, which may contribute to discrimination and prejudice against female researchers (Carli et al., 2016). Prior research has demonstrated that female researchers suffer when their extramural proposals are judged primarily on the strength of their curriculum vitae or biosketch, (Eaton et al., 2020; Guglielmi, 2018; Tamblyn et al., 2018; Witteman et al., 2019). Witteman et al. (2019) reviewed over 23,918 grant applications from 7,093 principal investigators and concluded that, "gender gaps in grant funding are attributable to less favourable assessments of women as principal investigators, not of the quality of their proposed research" (p. 531).

While great progress has been made, female researchers are still not achieving the same level of sustained success and promotion as their male counterparts. The purpose of this investigation was to explore whether research administrators contribute to this disparity in their evaluation of faculty. Specifically, this study evaluated if research administrators assess applicants differently due to biased assessments of their gender for multiple career ranks. The present work goes beyond previous examinations of gender and stereotypes by exploring the potential impact of research administrator's gender bias on female academic productivity. Research administrators play a pivotal role in the development of strategic, catalytic, and capacity-building activities designed to encourage academic researchers in attracting extramural research funding (Ross, 2017). Our hypotheses were generally supported by the data. Gender bias was not significant across male and female applicants in research administrator's evaluations of applicant biosketches for extramural research funding applications.

Preliminary Analysis

Overall, research administrators rated the biosketches favorably, with the median responses for all questions scored as 3 (somewhat) or higher (Table 3). Each research administrator reviewed two biosketches, each of a different gender and career rank, and the average difference in the Likert response between biosketches was less than 1 for all questions, suggesting that research administrators tended to respond similarly to each biosketch as a group.

Research administration is a predominately female-dominated profession with over 80% of the profession being women worldwide, and 83.5% being women in the United States (Kerridge & Scott, 2018). Consistent with these findings, study participants were 82.9% female, with 17.1% male. Regarding institution size, the majority of participants were from a large institution with more than 25,0000 students/employees (42.9%), with equal representation from small and medium organizations (28.6%, respectively). Lastly,

nearly all participants were from the United States (91.4%), with one participant each from Africa, Asia, and Europe (Table 2).

Participant expertise was largely noted as pre-award (77.1%) administrators who mainly work in grant-writing and proposal development (60.0%), and administration management (57.1%). Followed closely by research development (54.3%), research support operations (51.4%), leadership and professional development (45.7%), post-award (45.7%), management and operations (45.7%), and departmental administration (40.0%). Additional expertise noted included executive or senior leadership (31.4%), financial management (31.4%), research ethics/integrity/compliance (31.4%), clinical and translational research (25.7%), research contracts and law (11.4%), legal issues (5.7%), technology development/transfer (5.7%) and human resources (8.6%).

HYPOTHESIS 1: APPLICANTS RATED SIMILAR IN RESEARCHER COMPETENCE.

Contrary to previous research examining faculty gender biases and stereotypes, our findings show that extramural applicants were rated similar in competence and hireability across both male and female applicants by research administrators (Hypothesis 1). This finding, while preliminary, suggests that traditional barriers related to perceived female researcher competence are not experienced as they interact with research administrators. One implication of this is that research administrators do not play a significant role in the negative judgment or treatment of female researchers. However, with a small sample size, caution must be applied, as the findings need additional investigation.

Gender Evaluations and Research Networks

Given that the research administrative profession is largely female (85%), traditional barriers related to perceived female researcher competence may not be experienced as they interact with the largely female research administrator population. However, this is a complex and multifaceted topic in previously published literature. Two studies showed that evaluator's tend to prefer applicants of the same gender (Casadevall & Handelsman, 2014; De Paola & Scoppa, 2015); however, in two other studies conducted in the same disciplines, evaluators exhibited a preference for applicants of the opposite gender (Broder, 1993; Ellemers et al., 2004).

Recent literature suggests that academic female evaluators are not significantly more favorable toward female candidates. Bagues et al. (2017) examined 100,000 applications and 8,000 evaluators for the qualification evaluations for full and associate professorships in all academic fields. In general, findings suggest that female evaluators neither increases the success rate of female candidates, nor does it alter the quality of selected candidates. In fact, in all but one subsample, Bagues et al. (2017) observed the opposite pattern in success rates; committees with a larger percentage of female members tend to be relatively less favorable toward female candidates. No empirical literature exists examining the relationship between female research administrators and female researchers.

Another consideration is that research networks tend to be gendered (Boschini & Sjögren, 2007; Hilmer & Hilmer, 2007). Zinovyeva and Bagues (2015) suggest that male candidates may receive higher scores as they are more likely to be more acquainted with evaluators and would benefit from these connections. The parameters of this study eliminate any benefit from previously established relationships as the biosketches were fabricated by the study team and no possible connection could have been recognized with any participating research

administrator. However, in the real-world setting, connections between established researchers and their research administrators may play a significant role in applicant evaluation, with or without gender or stereotype implications. More empirical work is needed to understand these connections and the impact of gender evaluations in research administration in this context.

HYPOTHESIS 2: FEMALE APPLICANTS RATED HIGHER IN COLLEGIALITY AND MENTORING POTENTIAL.

Our research also showed that female applicants were generally seen as more likeable (researcher collegiality) and were rated higher for mentoring potential than male applicants (Hypothesis 2). These traits may be perceived as communal and more typical of women than men (Carli et al., 2016; Eaton et al., 2020). While female researchers may score high on mentoring potential, their full potential is rarely reached and there are still stark gender inequalities in research career development.

Inaccessible Mentoring Potential

Female (and especially attractive female) leaders, regardless of their discipline and the reason they were chosen to lead, are consistently rated higher than their male faculty counterparts (Hamel, 2014). Female applicants are consistently rated higher in collegiality and mentoring potential; and yet research also confirms that mentoring potential is often never fully realized in female researchers (Cross et al., 2019). The typically lower faculty status and profile of female researchers, together with the need to align personal factors and ensure a good match, limit female researcher access to quality mentors (Steele et al., 2013). Female faculty can find it difficult and time-consuming to find a suitable research mentor with similar interests (Levine et al., 2011). Personal and social dynamics were heightened for some female researchers due to individual attributes such as gender, age, cultural differences, past experience and changing needs (Wasserstein et al., 2007).

Mentoring specifically for female researchers in academic medicine has been frequently explicitly or implicitly regarded as an intervention with the goal of reducing gender inequalities in career development, but to date there has been no publications that link mentoring to theories about the origins of such inequality (House et al., 2021). Over 4,200 articles have been published since 2006 specific to mentoring schemes to reduce gender inequalities in academic medicine, and yet no robust evidence of effectiveness in reducing gender inequalities has been reported. For those articles where mentoring was aimed at supporting female researchers, there was little description of what constituted gender-specific mentoring, the terminology used to describe mentoring was inconsistent, and reported outcomes were not gender-specific—limiting further scholarly discourse (House et al., 2021).

One commonly discussed reason for lack of mentorship in the field is that faculty may not want to appear to meet alone with a faculty member of the opposite gender for fear of sexual harassment, false accusations, or the appearance of impropriety. Likewise, some men reported difficulty giving criticism to women (Koopman & Thiedke, 2005). This can create problems for mentoring females in male-dominated fields, even though mentoring is critical, and department relationships are a key component of the climate that may cause women to leave scientific fields (Bates et al., 2016; Callister, 2006). Patton et al. (2017) speculated that female mentees may have less powerful mentors, resulting in diminished academic

success, and that mentors may be less likely to think of female mentees for research mentorship opportunities. Although research is a necessary component of promotion, overall female faculty members tend to spend more time teaching and engaging in service activities, whereas male faculty allot more time for research endeavors (Hill et al., 2005; Varnado-Johnson, 2018). The opposite gender theory behind mentoring and the bias it may bring may be less prevalent in our population as the research administrators were primarily women working with female scientists.

HYPOTHESIS 3: SENIOR CAREER RANK APPLICANTS RATED HIGHER IN RESEARCH COMPETENCE AND SKILL.

Furthermore, consistent with prior research, findings suggest that those in the senior career rank were more highly rated for research competence and skill (Hypothesis 3). Specific to this study, only half of the participants reported feeling at least moderately qualified to evaluate a biosketch; and yet, as a whole, all participants were able to rank and recognize the skills of senior level faculty as higher throughout the study. This finding upholds the success of the study team in creating realistic biosketches and reasonable skill of the research administrators in their ability to evaluate a biosketch.

Associations Between Gender and Rank

Although we did not list a formal hypothesis, our findings did support the notion that senior career rank applicants are more highly rated for biosketch design and comprehension, most likely due to their perceived competence and advanced experience.

In regards to the interaction between gender and career rank, the findings of this study showed that a positive association between female gender or higher career rank to the question, "How easy was it for you to navigate the biosketch," was diminished when the value of the other variable is high. A higher career rank is associated with favorable scores, but that positive association weakens for women; while a lower career rank weakens the positive association between gender and favorable score. In other words, being both female and having a higher career rank may drop the score, but it does not have major implications as the overall response was still favorable.

Limitations

The relatively small sample size hampered some statistical models and may not provide the statistical power to determine if the findings of this research are true for the general population. Notwithstanding these limitations, the study suggests that research administrators do not play a significant role in the negative judgment or treatment of female researchers. Several questions still remain to be answered. Considerably more work will need to be done to determine the effect Research Administrator's play on the development, productivity, and success of female researchers. If the debate is to be moved forward, a better understanding of how research administrators determine their workload, how that workload effects faculty productivity, and numerous other environmental factors which may influence academic researchers' productivity must be explored.

CONCLUSIONS

Female faculty remain a minority in academic research and women are often perceived to lack the qualities needed to be successful scientists, which may contribute to discrimination and prejudice against female researchers. Research administrators play a pivotal role in the development of strategic, catalytic, and capacity-building activities

designed to encourage faculty in attracting extramural research funding. The purpose of this investigation was to explore whether research administrators evaluate extramural grant applicants differently based on gender and different career ranks.

Contrary to previous research examining faculty gender biases and stereotypes, our study showed that applicants were rated similarly in researcher competence across both male and female applicants by research administrators (Hypothesis 1). Female candidates were generally seen as more likeable (researcher collegiality) and were rated higher for mentoring potential than male candidates (Hypothesis 2). Furthermore, applicants in the senior career rank were more highly rated for research competence and skill (Hypothesis 3) and for biosketch design and comprehension. These findings, while preliminary, suggest that traditional barriers related to perceived female researcher competence are not experienced as they interact with research administrators. The main implication of this study is that research administrators do not appear to significantly contribute to the previously reported discrimination and prejudice against the competence of female researchers.

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APPENDIX A – RESEARCH SURVEY

1. Participant Consent
2. Participant Screening
   a. What are your areas of expertise in research administration (check all that apply)?
      i. Clinical and Translational Research
      ii. Grant-writing & Proposal Development
      iii. Leadership and Professional Development
      iv. Pre-award
      v. Research Development
      vi. Research Support Operations
      vii. Administration Management
      viii. Departmental Administration
      ix. Executive or Senior Leadership
      x. Financial Management
      xi. Human Resources
      xii. Legal Issues
      xiii. Management and Operations
      xiv. Post-award
      xv. Research Contracts and Law
      xvi. Research Ethics/Integrity/Compliance
      xvii. Technology Development/Transfer
3. Randomization
   a. In order to facilitate randomization, please select the group with the first letter of your last name:
      i. Group A-F
      ii. Group G-L
      iii. Group M-R
      iv. Group S-Z
4. First Biosketch
   a. Please open and review the first biosketch.
   b. Which biosketch did you receive? Please type the first and last name of the individual listed at the _____ top of your biosketch.
5. Design and Comprehension (1 - Not at all 2 - Slightly 3 - Somewhat 4 - Moderately 5 – Extremely)
   a. How easy was it for you to navigate the biosketch?
   b. How complete or comprehensive was the information in the biosketch?
   c. How professional was the biosketch?
   d. How well-written was the biosketch?
6. Researcher Competence and Skill (1 - Not at all 2 - Slightly 3 - Somewhat 4 - Moderately 5 – Extremely)
   a. Based on the biosketch you read, did the applicant strike you as competent?
   b. How likely is it that the applicant has the necessary skills for the research project?
   c. How qualified do you think the applicant is?

7. Grant Fundability (1 – Extremely Unlikely 2 - Unlikely 3 - Neutral 4 - Likely 5 – Extremely Likely)
   a. How likely would you be to encourage the applicant to submit an NIH grant, assuming it is appropriate for their level of training and experience?
   b. How likely do you think it would be for the applicant to make the "first cut" (be in the top tier of applicants) if they applied for an NIH grant?
   c. How likely do you think it would be for the applicant to be awarded an NIH grant award?
8. Research Collegiality (1 - Not at all 2 - Slightly 3 - Somewhat 4 - Moderately 5 – Extremely)
   a. Based on the biosketch you read, how much did you like the applicant?
   b. Would you characterize the applicant as someone you want to get to know better?
   c. Would the applicant fit in well with other faculty members at your institution?
9. Mentoring Potential (1 - Extremely Unlikely 2 - Unlikely 3 - Neutral 4 - Likely 5 - Extremely likely)
   a. How likely would you be to encourage the applicant to stay in the field if he/ she was considering changing research topics?
   b. How likely would you be to encourage the applicant to continue to focus on research if he/she was considering switching focus away from research?
   c. How likely would you be to give the applicant extra help if he/she was having trouble mastering a difficult research concept?
10. Salary and Competitiveness
    a. Please indicate the starting salary you would recommend for the applicant at an institution like yours (in UNITED STATES dollars): _____
    b. Compared to the average applicant in Surgery for a position at an institution like mine, the applicant I just read about would rank in the top _____% for overall excellence (with lower numbers indicating a higher ranking).
11. Salary and Competitiveness (1 - Not at all Competitive 2 - Slightly Competitive 3 - Somewhat Competitive 4 - Moderately Competitive 5 - Extremely Competitive)
    a. How competitive overall is the candidate?
    b. How competitive is their honors record?
    c. How competitive is their grants and awards record?
    d. How competitive is their professional experience record?
    e. How competitive is their publication record? How competitive is their presentations and posters record?
12. Second Biosketch (Repeat Survey Sections 4 through 11.)
13. Participant Demographics
    a. How qualified do you feel to evaluate a biosketch? (1 - Not at all Qualified 2 - Slightly Qualified 3 - Somewhat Qualified 4 - Moderately Qualified 5 - Extremely Qualified
    b. Please list an email address to receive the study debriefing email.
    c. Your gender:
       i. Male
       ii. Female
       iii. Other
    d. Where is your home located?
       i. United States
       ii. North America (Non-USA)

   iii. Europe
   iv. Australia
   v. Asia
   vi. Africa
   vii. South America
e. What is the size of your institution?
   i. Small (Less than 10,000 students/ employees)
   ii. Medium (10,000 to 25,000 students/employees)
   iii. Large (More than 25,000 students/ employees)
f. Please list any additional comments or thoughts you might have about this study.