Spring 6-14-2019

Human Resource Initiatives Addressing Factors Impacting Organizational Gender Stratification and Performance: A Computational Study

Ashlyn Paige Lowe
DePaul University, ALOWE13@depaul.edu

Human Resource Initiatives Addressing Factors Impacting Organizational Gender Stratification and Performance: A Computational Study

A Thesis

Presented in

Partial Fulfillment of the

Requirements for the Degree of

Master of Arts

By

Ashlyn Paige Lowe

June, 2019

Department of Psychology

College of Science and Health

DePaul University

Chicago, Illinois

Thesis Committee

Goran Kuljanin, Ph.D. Chairperson

Alice Stuhlmacher, Ph.D.

Acknowledgements

I would like to express my appreciation and gratitude to Dr. Goran Kuljanin for not only his expertise and guidance throughout this process, but also his encouraging support. I would not be where I am today without his support. I would also like to thank Dr. Alice Stuhlmacher for her added insights to the development of this project. I thank Neal Outland and Jake Weiss for their kindness and support during my time in graduate school, as well as Melissa Vazquez and Tatem Burns for being the greatest cohort. From my time at Michigan State University, I thank Dr. Ann Marie Ryan and Dr. Danielle King for inspiring me to pursue I-O psychology and sparking my interest in gender studies. Finally, I would like to thank my parents (Tom and Dawn), my sister (Alyssa), and my dear friends (Lauren DiComo and Becca Clancy) for being the greatest support system I could ask for.

Biography

The author was born in Milford, MI on October 18, 1994. She graduated from Milford High School, in Highland, MI and received her Bachelor of Science degree in Psychology from Michigan State University in June of 2016.

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Abstract

Women remain underrepresented in the upper echelons of organizational management, which is known as organizational gender stratification (OGS). Individual processes, such as differential career choices between men and women, contribute to OGS, along with organizational processes, such as bias in performance appraisal evaluations. Furthermore, these factors hold implications for organizational workforce potential if promotion decisions depend on biased performance evaluations. The literature lacks an integration of these factors in examining their combinatorial dynamic effects, as well as an assessment of practical steps organizations can take to combat the cultivation of OGS. This study has two primary purposes. First, it examines how a set of five factors unfold over time and interactively lead to the emergence of key organizational outcomes such as OGS and organizational workforce potential. Second, it assesses the effectiveness of proposed human resource (HR) initiatives designed to reduce OGS and improve organizational workforce potential. To accomplish these goals, this study developed a computational model to conduct two virtual experiments on the set of factors responsible for OGS. The first virtual experiment focuses on examining the effects of the factors responsible for OGS, both individually and in combination. The second virtual experiment focuses on exploring how proposed HR initiatives may reduce OGS and ultimately improve organizational workforce potential. Results show that under three levels of bias (i.e., no bias, low bias, and high bias), differential patterns of OGS emerge based on the produced discrepancies between perceived performance and true performance of men and

women. In other words, organizations are not promoting their top talent due to held perceptions, which impacts workforce potential. These effects occur more rapidly and severely under high bias. Three bundles of HR initiatives (i.e., combating bias, removing familial effects, and evening the playing fields) also differentially impact OGS. Combating bias (i.e., removing bias in performance appraisal evaluations and selection) most strongly reduces OGS as a result of equalizing perceived and true performance evaluations. Improving parental leave, providing equal opportunities, and evening the playing field (i.e., having more women in line positions) were not as effective in reducing OGS. The implications of this study are twofold: 1) for researchers, focusing on underlying top-down and bottom-up processes provides a more nuanced understanding of psychological phenomena, such as OGS; 2) for practitioners, solving OGS involves assessing multiple factors, and has implications for workforce potential; the present study suggests focusing on reducing bias in performance appraisal and selection to combat OGS.

Human Resource Initiatives Addressing Factors Impacting Organizational Gender Stratification and Performance: A Computational Study

Organizations with underrepresentation of women in upper management positions persistently face organizational gender stratification (OGS), or the differences in the employment pattern of men and women in organizations (Perry, Davis-Blake, & Kulik, 1994). In 2018, women only held 22% of C-suite positions across U.S. companies (Women in the Workplace, 2018). Subtle disadvantages for women, such as fewer chances to meaningfully participate in meetings and differences in the amount of developmental opportunities for men and women, create an uneven playing field for women pursuing upper level managerial positions. Research attributes numerous factors to this leadership gap, such as career decisions individuals make (Wellington, Kropf, & Gerkovich, 2003), which lead to the subtle, yet cascading phenomenon of OGS. OGS not only has implications for those directly impacted (i.e., women), but also for organizations indirectly. Research finds gender-diverse organizations are more likely to bring in top talent, appeal to customers (Hunt, Layton, & Prince, 2015), and have increased positive financial returns (Hoobler, Masterson, Nkomo, & Michel, 2016; Hunt et al., 2015). This implies that management of human capital resources impacts organizational performance (Ployhart & Moliterno, 2011), thus organizations should be aware of the links between OGS and organizational workforce potential.

The “glass ceiling,” or the discrete barrier women and minorities face in the workplace that inhibits career progression (Crampton & Mishra, 1999), is a

phenomenon often used to describe OGS. Individual processes, such as differential career decisions of women and career delays (Wellington, Kropf, & Gerkovich, 2003; Women in the Workplace, 2016), remain a partial explanation for the glass ceiling effect. However, a large contributor to OGS comes from organizational processes. Differences in feedback and developmental opportunities received by women (Women in the Workplace, 2016), as well as bias against women in promotion (Lyness & Heilman, 2006), selection (Peterson & Saporta, 2004; Robison-Cox, Martell, & Emrich, 2007; Fernandez-Mateo & King, 2011; Dreher, Lee, & Clerkin, 2011; Azmat & Pertongolo, 2014; Women in the Workplace, 2016), and performance appraisal (Eagly, Makhijani, & Kloshy, 1992; Cohen, Broschak, & Haveman, 1998), additionally contribute to OGS. To combat OGS, researchers and practitioners encourage organizations to adopt human resources (HR) initiatives, such as expanding family and medical leave policies offered by companies such as FaceBook, Netflix, and Starbucks (McGregor, 2017), or training employees on how to avoid bias when evaluating performance (Anderson, Ahman, King, Lindsey, Feyre, Ragone, & Kim, 2015).

While previous research examined factors contributing to OGS in isolation, an integration of how these factors play out dynamically is needed. Moreover, researchers often attempt to study higher-level phenomena by combining individual level factors (e.g., gender bias) to explain organizational outcomes (e.g., OGS). OGS in organizations manifests as an emergent phenomenon where the consequences of behavior at the micro-level lead to a macro-level effect (Martell, Emrich, & Robison-Cox, 2012). OGS warrants a

multi-level approach to avoid misspecification of organizational-level phenomena by allowing for an examination of dynamically interacting factors that simultaneously produce OGS. Previous research offers insight to how organizations might combat OGS, yet, rarely assess the effectiveness of action taken by organizations in reducing OGS.

The proposed study aims to examine how OGS unfolds dynamically in organizations and what organizations can do to reduce OGS through HR initiatives. The proposed study bridges the gap between the study of OGS as a construct versus an emergent phenomenon by incorporating processes occurring at various levels (e.g., individual and organizational) that influence OGS in organizations, as well as the implications it holds for organizational workforce potential. This research uses computational modeling, which allows for an examination of how numerous factors interact over time to produce emergent phenomena and provide the opportunity to comparatively evaluate interventions to influence emerged outcomes (Harrison, Lin, Carroll, & Carley, 2007). The present study investigates how the adoption of various HR initiatives helps to reduce OGS and impacts organizational workforce potential.

Theoretical and Research Foundation for Studying Organizational Gender Stratification

Organizational gender stratification (OGS), or organizational segregation based on gender (Martell et al., 2012), is an emergent organizational phenomenon resulting from the dynamic interaction of individual and organizational processes (Kozlowski & Klein, 2000). Research on these processes provides evidence for

their effects on inequity in the workplace and a foundation for exploring their dynamic, interactive effects. The current study builds on this foundation and assesses the potential effectiveness of HR initiatives to reduce OGS while simultaneously impacting organizational workforce potential. To build a model of dynamically, interacting factors contributing to OGS, I outline each factor in detail to justify its importance to understanding OGS. I then propose HR initiatives to address each of the contributing factors and bundle them according to the most practical arrangement of initiatives organizations can use to inform their HR practices.

Factors Affecting Organizational Gender Stratification

Both individual and organizational processes contribute to OGS in organizations. Individual processes, such as differences in the careers chosen by women (Wellington et al., 2003), are often blamed for the lack of female representation in upper organizational levels. Organizational processes, such as differences in developmental opportunities given to women (Women in the Workplace, 2016), are also believed to play a subtle, yet crucial role in OGS. This study examines five factors contributing to OGS. These factors are: (1) career decisions, (2) familial effects, (3) bias in selection evaluations, (4) bias in performance appraisal evaluations, and (5) differences in developmental opportunities presented to men and women. The following section will discuss these individual and organizational processes in detail.

Individual Decision Processes. Individual decisions play a fundamental role in determining career paths (Wellington et al., 2003; Woodcock, Hernandez,

Estrada, & Schultz, 2012). Two critical individual decision processes impacting OGS are the pursuit of challenging jobs and work-life prioritization (Wellington et al., 2003; Sandberg, 2013). If women and men systematically differ in their individual decisions, then this generates pathways for the emergence of OGS in organizations.

Career Decisions. Females are more likely to occupy staff positions in organizations where they play a support role, such as in Human Resources (HR), whereas males are more likely to occupy line positions where they receive greater responsibility over factors influencing an organization's profits or losses (Catalyst, 2006). Importantly, experience in line positions provides crucial experience for managerial careers (Wellington et al., 2003). One possible explanation for females pursuing line positions with less frequency includes domain disidentification in which individuals separate themselves from a discipline due to chronic stereotype threat (Woodcock et al., 2012). An individual reduces his or her social identity when stereotypes of a given group include psychological and behavioral consequences for minority groups members, such as minority group members reinforcing a given stereotype. Social identity threat may differ amongst individuals as a result of situational cues regardless of a person's confidence in a given domain. For example, Murphy et al. (2007) examined the influence of an individual underrepresented within a group (i.e., belonging to a numerical minority). They found that when women were primed to feel as though they belonged to the numerical minority, they reported feeling they did not belong at a conference, and thus, were less inclined to participate at the conference as a

result. The results from this study indicate that when women identify with a given domain, they tend to rely on situational cues, such as numerical representation, to obtain information on threats to their identities in reference to numerical representation (Murphy et al., 2007). Furthermore, the simple influence of gendering words in a masculine manner can also discourage women from applying for certain jobs due to the feeling that women do not belong in these jobs (Breaugh, 2013). If women tend to self-select out of positions deemed important for higher-level positions in organizations, then this provides a pathway for the emergence of OGS. Thus, it is imperative that women pursue line positions if they wish to garner higher-level managerial positions.

Familial Effects. Another barrier women tend to face in their career advancement stems from familial choices, such as deciding to have children. The 1993 Family and Medical Leave Act offers 12 weeks of unpaid leave for mothers in the U.S. and guarantees an individual the same job or a job of similar rank upon returning to work after taking leave (FML Report, 2012). Additionally, more women tend to take leave compared to men as a result of conceiving a child (FML Report, 2012). Although the passage of this act increases employment and retention for women once they conceive a child, their wages often decrease upon returning to work (Hofferth & Curtin, 2006). Multiple studies indicate that even after controlling for age, work experience, and education, women receive lower wages for choosing motherhood compared to those who do not (Waldfogel, 1996; Avellar & Smock, 2003). Organizations also do not entice women to return to work after conceiving children, and thus, this motherhood penalty may lead to

women missing out opportunities to fulfill their leadership potential. In fact, approximately 43% of women leave their jobs once conceiving children (Sandberg, 2013), terminating a woman's career progression and exacerbating OGS in organizations. Systematic differences in the frequency with which women and men take leave creates another pathway for the emergence of OGS. Taking a leave of absence also relates to fewer promotions, lower salary, and lower performance evaluations for the year in which an individual took leave (Judiesch & Lyness, 1999), mothers especially. However, research finds men often receive a performance bonus if they are fathers (Hodges & Budig, 2010).

Organizational Evaluation Processes. Organizational evaluations play a role in determining career trajectories and organizational effectiveness (Eagly, Makhijani, & Kloshy, 1992; DeNisi & Murphy, 2017). Three critical evaluative organizational processes include selection, performance appraisals, and promotion (Salgado, Viswesvaran, & Ones, 2001; DeNisi & Murphy, 2017; Cleveland, Murphy, & William, 1989). If evaluative organizational processes function differentially for men and women, then they provide multiple pathways for the emergence of OGS with implications for organizational workforce potential.

Social role theory describes how individuals act in social situations, which stems from their social roles (Katz & Kahn, 1978; Eagly, 1987). Social roles provide descriptive information by conveying ways individuals act in a given situation and prescriptive information that explains ways individuals should act (Eagly, 1987). Social roles include gender roles (Eagly & Karau, 2002), where men are thought to possess more agentic characteristics, such as being

independent, dominant, and assertive (Wood & Eagly, 2012), and women are thought to possess more communal characteristics, such as being affectionate, sympathetic, and interpersonally sensitive (Bakan, 1966; Wood & Eagly, 2012). Moreover, individuals typically think of agentic characteristics (e.g., competitive, ambitious) when thinking of successful leaders (Schein 1973, 1975). Building on social role theory, role congruity theory posits individuals tend to get evaluated based on the amount of alignment they exhibit with their prescribed gender roles (Eagly & Karau, 2002). Those possessing agentic characteristics more closely resemble leaders, which results in incongruity when an individual does not align with their gender-stereotypic characteristics. For example, thinking of a female leader can elicit stereotypes about both women (i.e., communal characteristics) and leaders (i.e., agentic characteristics), resulting in role incongruence (Eagly & Karau, 2002), or a perceived lack of fit between being a female and being a manager (Fiske, 1993).

These role expectations hold implications for selection, performance evaluation, and promotion processes. According to leader categorization theory, individuals form mental representations of leaders due to held perceptions (Lord, Foti, & De Vader, 1984). Individuals use these schemas to classify the traits or attributes expected of leaders into cognitive structures known as implicit leadership theories (Offermann & Coats, 2018). Implicit leadership theories (ILTs) can influence an individual's behavioral expectations of a leader based on some archetype of desired leader behaviors (Offermann & Coats, 2018). ILTs influence leadership ratings with ratings biased by inaccurate representations of

leader behaviors that might not necessarily be occurring (Shondrick & Lord, 2010; Offermann & Coats, 2018). While the "think manager, think male" mindset (Schein, Muller, Lituchy, & Liu, 1996) may exist to a lesser degree with approximately half of management jobs in the U.S. occupied by women (Catalyst, 2014), Offermann and Coats (2018) discuss differences in perceptions of creative potential between men and women as a potential source of the limited number of women occupying male-dominated jobs. Proudfoot, Kay, and Koval (2015) found creativity more strongly tied to masculine characteristics compared to feminine characteristics, and female executives are rated as less innovative than their male counterparts. Offermann and Coats (2018) argue this helps shed light on the scarce number of women in STEM (science, technology, engineering, mathematics) careers due to a heightened emphasis placed on creativity and innovation. Moreover, individuals tend to evaluate the women they view as successful managers as also being more irrational and hostile than their male counterparts (Heilman, Block, & Martell, 1995). As a result, this unconscious bias exists in the screening and evaluation of female candidates for leadership roles, making it more difficult for women to receive consideration for leadership roles (Eagly & Karau, 2002). Recent research also finds the importance of implicit followership theories (IFTs; Braun, Stegmann, Hernandez Bark, Junker, & van Dick, 2017), or beliefs as to how followers should act, in that individuals use social roles to evaluate who is a successful follower based on an individual's personal attributes. The follower role is comprised of being agentic and task-oriented, but also, places emphasis on person-orientation (Junker & van Dick,

2014; Junker et al., 2016; Sy, 2010; Braun et al., 2017). Additionally, women are held to higher expectations for acting in communal manners when evaluated (Bear, Cushenbery, London, & Sherman, 2017). As a result, women are held to IFTs and experience a "pull effect" towards follower roles due to alignment with their gender roles, whereas men experience a "push effect" from follower roles, pushing them into leadership positions due to better alignment with leadership roles. This phenomenon, known as a "sticky floor," restrains women into follower positions due to the perceived congruence between being a female and being a follower rather than a leader (Braun et al., 2017).

Women in line positions are also rated lowest compared to all other management groups, such as women or men in staff positions, or men in line positions (Lyness & Heilman, 2006). Women in these positions tend to experience a disadvantage in performance evaluations compared to women in staff positions and men in both line and staff positions. This finding limits the potential for women to reach higher-level positions given the importance of possessing line experience for managerial success (Wellington et al., 2003).

As a whole, these findings suggest that for women pursuing management careers, gender bias can harm performance evaluations, and ultimately, hinder promotional opportunities and career progression for women. Performance ratings influence subsequent promotions, and research suggests women who receive promotions obtain higher performance ratings compared to men who receive the equivalent promotions (Lyness & Heilman, 2006). This implies that, in order for women to receive promotions, they had to be viewed as more exceptional in their

accomplishments compared to men. In other words, to be at the same level as men, women must work harder than their male counterparts (Lyness & Heilman, 2006).

Selection Evaluation Bias. Organizations are more likely to hire men than women, and this male advantage increases with each organizational level (Women in the Workplace, 2016). As leadership roles become more prevalent with increasing organizational levels, these findings are not surprising from a role congruity perspective (Eagly & Karau, 2002). In other words, the closer women are to upper management, the more perceived incongruity manifests when evaluating women as leaders (Eagly & Karau, 2002). Additionally, due to differences in career selection between men and women into line and staff positions and how organizations more highly value line positions in comparison to staff positions (Wellington et al., 2003), women in external labor pools are disadvantaged when considered for open positions in an organization.

Performance Appraisal Evaluation Bias. Foschi's (1992, 1996, 2000) theory of double standards suggests that when evaluating performance, individuals use a different set of standards to evaluate the same performance based on gender to make a decision about an individual's competence. Members of lower status groups (in this case, women) are evaluated with stricter standards for the same performance. As an example, research in the Netherlands finds students to be biased against female lecturers in their performance ratings (Mengel, Sauermann, & Zölitz, 2017). Female lecturers were rated lower than male lecturers, even when the teaching materials used by the lecturers were

exactly the same. Particularly surprising, students of the lecturers received similar course grades, and course grades improved at similar rates for courses taught by both male and female lecturers. Additionally, female lecturers received lower ratings by both male and female students, and these ratings saw an even sharper decline when the lecturer was a junior instructor (Mengel et al., 2017). Together, these findings suggest prohibitive barriers to promotion as a result of biased performance appraisal evaluations, which lead to lower overall performance ratings. To the extent such biases exist in an organization, OGS may emerge.

The biases women experience in performance appraisal evaluations impact promotion decisions. It is more difficult for women to receive promotions to higher academic ranks compared to men, even after controlling for personal attributes such as publication history and career breaks, supporting the notion that women must work harder to receive outcomes on a similar level as men (Ward, 2001). For example, women do not receive promotions at the same rate as men: for every 100 women promoted, approximately 130 men get promoted (Women in the Workplace, 2016). Furthermore, if biases exist in performance appraisal evaluations, organizations may fail to promote their top performers.

Differences in Opportunities. As discussed previously, women experience differential selection, performance evaluation, and promotion processes. On average, women receive work less challenging compared to men. Only 67% of women (compared to 74% of men) report meaningfully partaking in meetings, 62% report receiving a challenging assignment (compared to 68% of men), and only 56% (compared to 63% of men) report being asked for their opinion when it

comes to important decisions (Women in the Workplace, 2016). Not only are women less appreciated and trusted compared to men, but only 49% of women (compared to 63% of men) report believing the input they give in their jobs is truly valued (Women in the Workplace, 2016). When it comes to fairness perceptions in the workplace, only 54% of women believe they are given equal opportunities for growth compared to peers and only 44% of women believe that opportunities in the workplace are allocated to the employees that truly deserve them (Women in the Workplace, 2016). Moreover, 33% of women report feeling difficulty in obtaining a raise, promotion, or advancing in their careers based on their gender, which nearly triples the percentage of men who feel their gender puts them at a disadvantage (Women in the Workplace, 2016). Kantola (2008) describes this phenomenon as a gendered division of labor in that the opportunities given to women are less valuable, often aligning with the female gender role, such as organizing social events (Eagly & Karau, 2002). As a result, women less often get the chance to display the necessary knowledge, skills, and abilities to advance in organizations.

Women also are less inclined to ask for increased responsibility or opportunities at work. Female Ph.D. students at Carnegie Mellon University discovered the reason they were assigned as teaching assistants to other faculty members while the male students were teaching their own courses was due to the male students simply asking for this increased responsibility (Babcock & Laschever, 2008). When women miss out on developmental opportunities, they lose the chance to develop the necessary skills to prepare them for managerial

success, which can cause women to be overlooked when it comes to promotions. When an individual is passed over multiple times for various promotions, it signals that he or she is not suitable for future promotions which lowers their chances of being considered for future promotions (Martell et al., 2012).

As a result, it is crucial women receive developmental opportunities within organizations to foster skills necessary to not only improve perceptions as management material, but to successfully execute managerial roles. Feedback on performance is also important for skill development and instrumental to an individual's learning, motivation (Kluger & DeNisi, 1996), goal attainment (Schiemann, 2009), and job performance (Erez, 1977). Even when women are presented with more opportunities in their jobs, they do not receive the necessary feedback to successfully grow in their roles. For example, only 36% of female employees reported receiving feedback "sometimes", "often", or "very often" compared to 46% of the male employees. More specifically, 20% fewer women reported receiving difficult feedback they felt was necessary for improving performance (Women in the Workplace, 2016). Without developmental opportunities or feedback on how one is performing, women cannot know where they currently stand within an organization and may lack insight on how to improve performance for increased responsibility in their jobs.

Summary. To summarize, women face barriers to career advancement at all levels of the organizational hierarchy (Baxter & Wright, 2000; Elliott & Smith, 2004; Eagly, 2007), which partially results from biases in selection, performance appraisal evaluation, and differences in developmental opportunities between men

and women. Individual decisions, such as career and familial decisions, present additional challenges to the career progression of women. Table 1 provides a summary of the factors contributing to OGS. These factors result not only in OGS, but also, can affect organizational workforce potential by failing to accurately select and promote individuals based on true ability.

Table 1
Factors Influencing Organizational Gender Stratification.

Factors	Descriptions	Process Level
Career Decisions	Women hold more staff positions, where they play a supporting role, whereas men hold more line positions, where they hold greater responsibility over an organization's profits or losses (Catalyst, 2006)	Individual Decision Process
Familial Effects	More women take leave compared to men, which holds implications for promotions, salary, and performance evaluations (Judiesch & Lyness, 1999); approximately 43% of women leave after conceiving children (Sandberg, 2013)	Individual Decision Process
Selection Evaluation Bias	Lack of fit between being a female and being a manager; men more likely hired into an organization compared to women, and this male advantage increases with each organizational level (Fiske, 1993; Women in the Workplace, 2016)	Organizational Process
Performance Appraisal Evaluation Bias	Foschi's (1992, 1996, 2000) theory of double standards states individuals use a different set of standards to evaluate the same performance based on gender; members of lower status groups (e.g., women) get evaluated with stricter standards for the same performance (Mengel et al., 2017)	Organizational Process
Differences in Opportunities	Women given less challenging work and report receiving less critical feedback than men; women report feeling their input not truly valued (Women in the Workplace, 2016);	Organizational Process

women seek fewer developmental opportunities
(Babcock & Laschever, 2008)

Human Resource Initiatives to Reduce Organizational Gender Stratification

The five factors discussed represent actions and decisions that may lead to OGS. While not readily apparent that women receive fewer developmental opportunities than men in organizations, this subtle difference can largely impact the likelihood of developing the necessary skills to grow in one's position and to demonstrate the capability to succeed at the next organizational level. Recognizing these subtleties exist is a step toward reducing OGS, and organizations need to take action to combat these problematic effects, not only to reduce OGS, but to increase organizational workforce potential. If organizations do not promote their top talent due to reduced performance perceptions of women, then organizational workforce potential suffers. Organizational gender studies typically provide suggestions of how to reduce OGS in organizations but fail to examine the effectiveness of HR initiatives to address the specified problems (Anderson et al., 2015). By examining the effectiveness of HR initiatives to reduce OGS in a formalized model, practitioners may better select interventions for an organization. The following sections review potential HR initiatives organizations can adopt to tackle each of the five factors contributing to OGS.

Even the Playing Field. OGS begins with the career choices women and men make. Women tend to occupy more staff positions, whereas men occupy more line positions. Additionally, upper level managers are more likely to be

selected from a line position pool (Catalyst, 2006; Wellington et al., 2013), thus placing the starting line for women behind that of men. It is difficult to assess the true impact and potential benefit of more women in managerial careers without actively working to bring women into these roles. Addressing this phenomenon requires an environment in which all employees feel safe, supported, and confident to pursue career paths of their choosing without fear of failure or backlash. One of the factors dissuading women from pursuing these careers is the sense they belong to a numerical minority in managerial careers (Murphy et al., 2007). Organizations can create an environment encouraging diversity, and regardless of the current gender composition of the organization, women should receive equal consideration as men for managerial positions. By creating an environment where men and women can achieve success in managerial careers, women should feel more confident to pursue stereotypically male careers, and this will increase the number of women in the applicant pool for open positions. To encourage women to pursue stereotypically masculine careers, organizations can write job postings in a gender-neutral tone to avoid discouraging women from applying (Breaugh, 2013). Moreover, organizational policies, such as affirmative action, which encourage women to pursue opportunities, can increase the number of women willing to enter competitive activities (Balafoutas & Sutter, 2012). Taken together, this implies simply informing women they will compete in a fair competition may increase the likelihood they will pursue situations they typically might avoid.

Remove the "Motherhood Penalty." In comparison to other high-income countries, the United States falls far behind in mandating paid maternity leave (Gault, Hartmann, Hegewisch, Milli, & Reichlin, 2014). Research shows providing paid leave for mothers increases the odds women will return to work after conceiving a child, and also tends to reduce employer costs by increasing employee retention (Gault et al., 2014). In 2013, approximately 87% of U.S. employees from 11,893 worksites received access to unpaid family leave, whereas only 12% received access to paid family leave (Gault et al., 2014). A few U.S. states already adopted paid leave policies for new mothers (i.e., California, New Jersey, Washington State, and Rhode Island) with varying amounts of pay provided for women for different durations of leave (Gault et al., 2014). Organizations retain more female employees after childbirth when they grant women maternity benefits compared to when they do not grant such benefits (Waldfogel, 1996), implying that inequities exist across companies for women in relation to leave policies. For example, companies such as FaceBook, Netflix, and Starbucks offer benefits for employed mothers, including paid leave and/or longer leave periods. By providing paid medical leave, organizations can support employees, which may increase retention and career progression for these individuals (Boswell, Colvin, & Darnold, 2008).

Reduce Selection Bias. The bias women experience in pursuing career goals begins with organizational selection decisions (Women in the Workplace, 2016). Individuals often rely on heuristics, or mental shortcuts, when making decisions (Tversky & Kahneman, 1974), which helps explain why stereotypes

persist. When hiring individuals for managerial positions, it is imperative that those making the hiring decisions receive only relevant information during screening of job applicants. If organizations utilize interviews during the hiring process, then those making hiring decisions should receive training on how to use only the necessary objective information to make a decision. Furthermore, decision-makers should receive as much time as needed to make the proper hiring decision to avoid the use of heuristics (i.e., stereotypes) in selecting candidates.

Organizations should conduct interviews in a standardized manner to ensure consistency of evaluation across job candidates. In addition, interviews should strive for objectivity, and tap into specific, behaviorally-oriented, and job-related criteria (Williamson, Campion, Malos, Roehling, & Campion, 1997). Multiple interviewers improve reliability and validity of interviews, and generally offer organizations protection against unlawful employment discrimination (Williamson et al.,1997). Furthermore, to increase the consistency of interviews across job candidates, employers should use multiple interview scales with detailed anchor ratings, use the same interviewers for all job candidates, and should not discuss the job candidate in question amongst interview raters to avoid any non-job-related evaluations during the selection of job candidates (Campion, Palmer, & Campion, 1997).

Reduce Performance Appraisal Evaluation Bias. To lessen bias in performance evaluations, organizations can give individuals providing employee ratings more performance information to allow for more accurate ratings as well as allowing uninterrupted time for making evaluations and increasing rater

accountability (Roberson et al., 2007). Organizations can use multi-rater systems to avoid bias from a single individual, as well as encouraging managers to build trust and relationships with all subordinates, regardless of gender (Applebaum, Roy, & Gilliand, 2011).

To increase the accuracy of performance evaluation ratings, organizations can provide frame of reference (FOR) training (Hauenstein, 1998). FOR training involves defining performance dimensions to rate individuals and providing examples of behavioral incidents to illustrate the desired behavior of each dimension. FOR training provides raters with the necessary standards to evaluate employees fairly by focusing on accuracy of performance evaluation decisions. Research suggests FOR is an effective strategy for training raters to increase not only the behavioral accuracy represented in a rater's mind, but also the accuracy of the performance evaluation rating itself (Woeher & Huffcutt, 1994).

Raters can also receive training on using methods shown to reduce gender bias. Structured free recall (SFR) asks raters to consider both positive and negative behaviors that an individual enacts to avoid basing ratings of an individual on general evaluations (Anderson et al., 2015). Bauer and Baltes (2002) found this method reduces bias against females when their performance gets evaluated. Under source monitoring (SM), raters differentiate between "known" and "remembered" judgments. Raters tend to view remembered judgments as more objective, or not influenced by personal thoughts and feelings, and therefore, less influenced by behavioral expectations (Anderson et al., 2015). Error management training (EMT) initiates an active learning process where

raters make errors so they can learn from the errors to promote self-regulation in their behavior (Anderson et al., 2015). Organizations can adopt any of these rater-training approaches to bring gender bias-awareness to employees to reduce rating errors.

Organizations often rely on performance evaluations to make promotion decisions (Cleveland et al., 1989). Research finds a promotion bias amongst men such that men prefer to support and promote male leaders (Bosak & Sczeny, 2011), which results in a self-perpetuating cycle of male-dominated management (Braun et al., 2017). Thus it is imperative that organizations make promotion decisions through a fair process. As mentioned previously, bias in performance evaluation ratings can be reduced by using various rater training strategies (i.e., FOR training, SFR, SM, EMT). By adopting these training methods to avoid bias in performance appraisal evaluations, those providing performance appraisal evaluations will base evaluations on more objective information by focusing on concrete, observed behaviors. As a result, ideally the candidates considered for promotions truly perform well in their current jobs, and thus, are best suited for a promotion.

Provide Equal Opportunities. Even if women pursue jobs needed for managerial careers, receive equal chances for hiring, and are evaluated without bias, women may not receive the same developmental opportunities as men in the same jobs (Women in the Workplace, 2016). At the same time, women do not ask for developmental opportunities at the same rate as men (Babcock & Laschever, 2008). This keeps women behind in development for top management positions.

Organizations need to track who receives developmental opportunities at work, and women need to actively seek out opportunities by asking their managers for greater responsibilities. Women need feedback on work performance and needs for improvement. Every employee, namely supervisors and managers, should feel safe to provide feedback to both women and men with the same quality and focus on developing an individual's skills. A proposed solution to equate developmental opportunities for men and women includes three components: (1) bringing awareness to differences in opportunity seeking propensity between men and women; (2) organizations equitably managing opportunities for training and development; (3) organizations equitably providing feedback to facilitate learning, motivation, (Kluger & DeNisi, 1996) and goal attainment (Schiemann, 2009), all critical for job performance (Payne, Youngcourt, & Beaubien, 2007).

Summary. Adopting HR initiatives to combat factors contributing to OGS serves two purposes. First, diversifying the leadership styles present in an organization can beneficially impact organizational success. Although research suggests increased diversity may not always lead to optimal performance, increasing gender diversity in organizations helps organizations expand their talent pool, increase employee satisfaction, and improve decision-making by enhancing creative perspectives (Hunt, Layton, & Prince, 2015). Moreover, with organizations adopting flatter organizational structures (e.g., Google; Gupta, 2016), where cooperation and coordination prove essential, participative leadership styles (i.e., styles exhibited by women) may prove more beneficial to these organizational structures due to more teams-based management (Applebaum

et al., 2003). Thus, female leaders can offer strategic value to organizations. Second, when evaluating females for leadership roles, biases held against women hold implications for organizational workforce potential. By evaluating females lower than males in organizations, and by overlooking individuals with lower performance evaluations, individuals with the highest perceived performance get selected and promoted to higher levels within the organization rather than those who truly perform the best. Thus, organizations may achieve sub-optimal performance levels due to not hiring and promoting the true top performers. Although the mechanism of the connection remains unclear, organizations with women in leadership positions tend to achieve effective financial organizational performance (Hoobler et al., 2016).

Organizations may adopt HR initiatives independently or in conjunction with other HR initiatives. While the HR initiatives reviewed all hold implications for OGS and workforce potential (see Table 2 for a summary), they do require time and effort by organizations. To influence career decisions of individuals, organizations may minimally alter current recruitment strategies by adjusting job postings to gender-neutral language (Breaugh, 2013). Providing paid maternity leave for women can potentially save organizations money by increasing employee retention after taking leave (Gault et al., 2014). Reducing selection bias involves allotting time and resources to properly structure the interview process and to train interviewers to accurately assess job candidates. Reducing performance evaluation bias requires a similar process in which raters need to receive training on how to accurately document and rate performance behaviors,

which involves investing resources and time into these processes. Reducing bias in promotions requires organizations to track current promotion processes and to ensure promotion decisions stem from accurate information. Finally, providing equal opportunities to males and females requires organizations to track who receives developmental opportunities, irrespective of who asks for them.

Table 2
Description of Human Resource Initiatives.

Factor	HR Initiative
Even the Playing Field	Gender neutral job postings (Breaugh, 2013); affirmative action for line position jobs (Balafoutas & Sutter, 2012)
Remove the "Motherhood Penalty"	Providing better medical leave (e.g., paid leave; Boswell, Colvin, & Darnold, 2008)
Reduce Selection Bias	Training for selection decisions; standardized interview process; multiple interviewers (Williamson et al.,1997; Campion et al., 1997)
Reduce Performance Evaluation Bias	Multi-rater performance appraisal systems; FOR training (Hauenstein, 1998); SFR, SM, EMT (Anderson et al., 2015)
Provide Equal Opportunities	Provide equal opportunities for increased responsibility (Babcock & Laschever, 2008); provide constructive feedback through performance management (Kluger & DeNisi, 1996)

Critical Factors for Organizational Workforce Potential

In understanding organizational workforce potential, organizations need to consider individual contributions to organizational objectives and goals.

Organizations need to evaluate individual contributions to organizational objectives from multiple perspectives including the execution and performance of normal job duties, and, especially in the context of considering individuals for promotions to higher-level (i.e., managerial) positions, leadership quality. Individual performance behaviors involve job-related activities that contribute to an employee's formal organizational role. In formal organizational roles, employees enact performance behaviors to accomplish tasks, duties, and responsibilities (TDRs) for their position. The execution of TDRs by employees serves as a fundamental contributor to organizational productivity (Ostroff, 1992). Naturally, another fundamental contributor to organizational effectiveness comes from managers enacting leadership behaviors. Not surprisingly, leadership effectiveness contributes to organizational performance (Jing & Avery, 2008). Furthermore, research findings suggest the quality of leadership exhibited by managers results in performance improvements of employees, especially in light of competitive organizational dynamics (Avolio, 1999; Lado, Boyd, & Wright, 1992; McGrath & MacMillan, 2000; Rowe, 2001; Tecee, Pisano, & Shuen, 1997). Thus, in order for organizations to successfully achieve organizational objectives and goals, organizations need employees who can successfully execute normal job duties and possess the potential to effectively lead fellow organizational members to accomplish stated organizational objectives and goals. Organizations that effectively reward such competencies will achieve superior organizational performance (Becker, Huselid, & Beatty, 2009).

Using Computational Modeling to Investigate Gender Stratification

OGS in organizations manifests as an emergent phenomenon where the consequences of behavior at the micro-level lead to macro-level effects (Martell et al., 2012). Previous research isolated various factors contributing to the lack of women in managerial positions but only limitedly examined their combinatorial effects. While empirical researchers examine how a set of factors relate to key outcomes, an often-neglected area of study in industrial and organizational psychology involves representing the interactive processes stemming from mechanisms underlying phenomena of interest (Kozlowski, Chao, Grand, Braun, & Kuljanin, 2013). For example, bias in performance appraisal serves as a contributing factor for why so few women in top management positions, yet it constitutes one piece to a complex, multidimensional, multilevel, and dynamic puzzle. Investigating the combinatorial and dynamic effects of these factors in a standard research setting necessitates first a thorough theoretical investigation. To achieve such a thorough theoretical investigation, I utilize computational modeling as an integrative approach to studying OGS.

Computational Modeling

Researchers traditionally examine psychological phenomena through narrative theory or limited empirical data investigations in industrial and organizational psychology. These approaches cannot sufficiently assess multiple interdependent processes operating simultaneously (Harrison et al., 2007; Kozlowski et al., 2013). To address this issue, researchers can utilize computer simulations to examine processes unfolding over time as a function of a set of inputs (Harrison et al., 2007). Computational models convert narrative theory of

psychological processes into a computer program to investigate theoretical logic, predictions, and implications (Kozlowski et al., 2013). Formulating a computational model involves utilizing equations, algorithms, and/or logical statements (Grand et al., 2016). Computational modeling allows researchers to build and assess theory, examine factors and processes underlying large-scale stratification in organizations, and design and assess potential interventions to resolve a persistent organizational problem (Martell et al., 2012).

Computer-based simulations of organizations can model both micro- and macro-level phenomena. Micro-phenomena represent ongoing processes at a lower-level of analysis (e.g., individuals) whereas macro-phenomena (e.g., organizational processes) represent situational constraints acting on lower-levels. Similarly, bottom-up phenomena originate at lower levels (e.g., individual) and exhibit emergent properties at higher levels (e.g., organizational; Kozlowski & Klein, 2000). Given the common representation of organizations as a multi-level system, OGS emerges as a result of interacting bottom-up and top-down processes. In the current study, individual- (i.e., career decisions and familial effects) and organizational-level processes (i.e., selection decisions, performance appraisals, and developmental opportunities) simultaneously contribute to the emergence of OGS and workforce potential.

Previous research utilized computational modeling to examine OGS. Martell et al. (1996) focused on organizational factors that influence OGS by assessing gender bias in performance ratings at various levels within an organization. They programmed an evaluation bias favoring male performance in

organizations to account for 1% and 5% of the variance in performance ratings which was used to make promotion decisions. Adding 2.01 bias points to performance of males accounted for 1% of variance in performance evaluations, and adding 4.58 bias points to performance of males accounted for 5% of variance in performance evaluations. Adding bias in favor of males to account for just 1% of the variance in performance evaluations resulted in females occupying only 35% of the highest-level management positions in the simulated organization (Martell et al., 1996).

Robison-Cox et al. (2007) expanded Martell et al.'s (1996) model by including differences between males and females in work experience, attrition, career delays, external versus internal hires, and risk-taking behavior in conjunction with bias in performance evaluations. Robison-Cox et al. (2007) defined work experience as an individual holding either a line or staff position in an organization. They also included differential attrition rates such that males and females left an organization for reasons including a lack of job opportunity at the current organization, job opportunities available at different organizations, and/or personal, family, or health reasons. Differences in career delays was defined as the possibility of a woman taking a year off for maternity leave. The authors also modeled risk-taking behavior, which represented increased risk-taking of males resulting in greater variance in performance evaluations for males. Robison-Cox et al. (2007) found these five additional factors did not produce OGS alone; rather, their combinatorial effects led to varying amounts of OGS in organizations.

Samuelson et al. (2018) also examined how both bottom-up (i.e., interpersonal) and top-down (i.e., contextual) processes interact to produce OGS with an agent-based simulation to focus on the interactive effects of developmental opportunities and external hiring rates of females in comparison to males. Both developmental opportunities and external hiring rates contributed to OGS by influencing the rate at which females voluntarily left the organization. The present study seeks to continue this line of research using computational modeling to comprehensively understand the processes impacting OGS and provide organizations an explanation of how OGS manifests, and evaluate ways organizations may combat negative outcomes from these processes to reduce OGS and positively impact organizational workforce potential.

Research Focus

This study examined how top-down (i.e., selection, performance appraisal, and developmental opportunities) and bottom-up processes (i.e., career and familial decisions) interact dynamically to produce OGS and limit women in upper level management using a computational model. The OGS model incorporated a set of factors as model parameters to examine their interactive effects in impacting OGS and workforce potential. Organizational workforce potential, defined in this study as the average of true ability of employees in an organization (Scullen, Bergey, & Aiman-Smith, 2005), is negatively affected when certain groups experience bias in the workplace. If women are rated lower on performance compared to men, they will tend to be overlooked when making promotional decisions. As a result, an organization may not promote its best

talent, and thus, organizational workforce potential can suffer. This study utilized two virtual experiments to understand the process of OGS and examine potential organizational interventions to reduce OGS. For each virtual experiment, a hierarchically-structured organization was initialized containing individuals with varying characteristics, including gender, age, retirement age, ability, and leadership quality. The first virtual experiment explored the theoretical space in which the OGS model parameters (i.e., OGS factors) operate. The second virtual experiment examined the effectiveness of HR initiatives designed to combat factors leading to OGS.

Virtual Experiment 1

The first virtual experiment (VE1) examines the theoretical space in which the OGS factors operate independently and simultaneously. VE1 assesses the effects of the model parameters by altering the parameter values. The model parameters in VE1 include: career decisions, familial effects, selection bias, performance appraisal evaluation bias, and differences in opportunities. VE1 allows for the alteration of the values comprising these factors in the model to examine how OGS unfolds over time, as well as the implications this holds for organizational workforce potential. Throughout VE1, it is suspected that due to the biases held against women in organizations, simulated organizations will not always promote or hire the top candidates due to incorrect perceptions of how an individual truly performs. Additionally, the simulation calculates OGS each simulated year to examine how OGS unfolds over time as a function of these contributing factors. While certain factors may subtly contribute to OGS, their

combinatorial effects were suspected to cumulatively exacerbate OGS over time. Thus, I propose:

Proposition I: Over time, organizational gender stratification will occur most severely in the upper levels of the organization.

Proposition II: Over time, perceived organizational performance will exceed true organizational performance in the presence of organizational gender stratification.

Virtual Experiment 2

The second virtual experiment (VE2) explores how altering the factors that affect OGS influence OGS and workforce potential. Following VE1, VE2 enacts HR initiatives, organized into bundles based on similarity between HR initiatives, to combat each of the OGS factors. The HR bundles represent underlying themes for organizations to consider when attempting to reduce OGS. The first bundle, "Combating Bias," addresses the bias that women experience during selection and performance appraisal processes. The second bundle, "Equal Opportunities", addresses the differences in developmental opportunities as well as the familial effects women experience throughout their careers. The final bundle, "Even the Playing Field," addresses the career decisions made by women. Table 3 provides an outline of each bundle.

Table 3
Human Resource Initiative Bundles Designed to Reduce Organizational Gender Stratification.

HR Bundle	HR Initiative	Rationale

Bundle 1: Combating Bias	Reduce Selection Bias Reduce Performance Evaluation Bias	To address bias in selection and performance appraisal against women
Bundle 2: Equal Opportunities	Provide Equal Opportunities Remove the "Motherhood" Penalty	To address differences in developmental opportunities and familial effects
Bundle 3: Even the Playing Field	Even the Playing Field	To address the career choices of women

Grouping HR initiatives into bundles allows for an examination of how effectively related HR initiatives reduce OGS and improve organizational workforce potential. I propose the following research questions to explore the effectiveness of the three HR bundles:

RQI: How and to what extent does reducing biases in (a) selection and (b) performance appraisal influence organizational gender stratification and organizational workforce potential?

RQII: How and to what extent does providing (a) equal developmental opportunities to males and females and (b) improved medical leave policies to employees influence organizational gender stratification and organizational workforce potential?

RQIII: How and to what extent does placing more women in line positions compared to staff positions influence organizational gender stratification and organizational workforce potential?

Method

This study examines five factors that produce OGS: (1) career decisions, (2) familial decisions, (3) selection bias, (4) performance appraisal evaluation bias, and (5) differences in opportunities. These factors are examined with respect to OGS and workforce potential. This study consists of two virtual experiments. The first virtual experiment examines the theoretical space in which the OGS factors operate by varying the model parameters to assess how they differentially impact OGS and workforce potential. The second virtual experiment explores the impact of HR initiatives designed to combat each of the OGS factors by altering the initial model parameters based on the bundle instantiated. This study evaluates the effectiveness of HR initiatives to reduce OGS and improve organizational workforce potential.

Simulation Set-Up

Virtual Experiments 1 and 2 utilize the same simulation set-up. First, the simulation sets the organizational life-cycle. Previous models of OGS used the number of years it takes to replace the organization with entirely new individuals (e.g., Samuelson et al., 2018) and find it takes approximately 36 years to do so, or used duration for organizational performance to reach equilibrium (Robison-Cox et al., 2007) and find it takes approximately 50 years for performance to plateau. Using these simulations as guidance, the simulated organizations in this study ran for 40 years for any given simulation run. The organizations were initialized with six levels, split into 50% line positions and 50% staff positions (Samuelson et al., 2018). Levels 1-3 represent the upper levels of the organization while levels 4-6 represent the lower levels. The number of employees set in the simulation is

11,490 to model a moderately large organization (Robison-Cox et al., 2007). Individuals in the simulation are assigned individual characteristics, which include gender, ability, leadership potential, age, and retirement age. At the start of any simulation run, the organization consists of 50% males and 50% females at all levels of the organization. Agent task ability and leadership potential are both drawn from a normal distribution with $M = 100$ and $SD = 15$, with upper and lower bounds set to 130 and 70, respectively. Agent age is drawn from a normal distribution, with the average age in the upper levels of the organization as $M = 55$, and the average age in the lower levels of the organization as $M = 35$, given employees in lower organizational levels tend to be younger in comparison to those working in upper-levels (U.S. Department of Labor, 2016). Agent retirement age is drawn from a normal distribution with $M = 65$ and $SD = 2$, with a lower bound set to 55. Agents in the external labor pool are hired based on their task ability, using the same sampling procedures for initializing the organization.

Virtual Experiment 1

Independent Variables (Factors). The OGS simulation consists of five parameters that model the factors contributing to OGS. These factors include differences in career selection, familial effects, bias in selection, bias in performance appraisal evaluation, and differences in developmental opportunities. These parameters were free to vary during VE1 to allow for an examination of how each of the factors interactively impact the outcomes of interest (i.e., OGS and organizational workforce potential). Within VE1, three conditions were created: no bias, low bias, and high bias. Parameters within these conditions were

altered to model the OGS processes that unfold within organizations with low bias and high bias operating, and to obtain an idealized organization without any OGS occurring.

Career Decisions. VE1 altered the number of women occupying line and staff positions to assess the impact of career decisions on the outcomes of interest. Previous models set the proportion of women in line positions to 30%, and the proportion of women in staff positions to 70% for OGS simulation (Catalyst, 2007; Robison-Cox et al., 2007; Samuelson et al., 2018). In VE1, women comprised between 10% and 50% of line positions depending on the simulation condition and organizational level, with the remaining number of women occupying staff positions. See Table 4 for exact career decision parameters.

Table 4
Proportion of Females Selected for Line Positions by Simulation Condition and Organizational Level.

	Organizational Level					
Simulation condition	1	2	3	4	5	6
No Bias	.50	.50	.50	.50	.50	.50
Low Bias	.25	.35	.40	.45	.45	.50
High Bias	.10	.15	.20	.25	.30	.50

Familial Effects. Previous computational models of OGS include a mechanism in which women have a set probability (e.g., 0.20) of removal from the internal labor pool in a given year to model the effects of taking maternity leave (i.e., Robison-Cox et al., 2007). Additionally, research shows a number of

women voluntarily leave their jobs once conceiving children. The 2012 Family Medical Leave Act, based on a 2011 a survey of 1,812 worksites across the U.S., found approximately 11% of men and 15% of women take leave in a 12-month period (FML Report, 2012). Additionally, previous research has noted women voluntarily turning over as a result of taking leave is approximately 40% (Sandberg, 2013). In VE1, the rates at which men and women took leave was set to 11% and 15% for the low and high bias conditions, and set to 13% for both males and females in the no bias condition. VE1 also examined different probabilities of turnover as a result of taking leave based on simulation condition, ranging between 10% and 40%. See Table 5 for exact familial effect parameters.

Table 5
Proportion of Males and Females Taking Leave, and Subsequently Leaving an Organization.

Simulation Condition	Proportion taking leave		Probability of turnover resulting from taking leave	
	Male	Female	Male	Female
No Bias	.13	.13	.20	.20
Low Bias	.11	.15	.15	.30
High Bias	.11	.15	.10	.40

Selection Bias. Previous models of OGS arbitrarily set the probability of external hires and the proportion of males in the external labor pool (Robison-Cox et al., 2007). In VE1, the probability of external hires was set to .30, .30, .25, .20, .10, and 1 for levels one through six, respectively (adapted from Robison-Cox et al., 2007). To account for external hiring bias against women, VE1 altered the

external hiring probability of women based on the simulation condition and organizational level. See Table 6 for exact selection bias parameters.

Table 6
Selection Probabilities of Females by Simulation Condition and Organizational Level.

	Organizational Level					
Simulation condition	1	2	3	4	5	6
No Bias	.50	.50	.50	.50	.50	.50
Low Bias	.25	.35	.40	.45	.45	.50
High Bias	.10	.15	.20	.25	.30	.50

Performance Appraisal Evaluation Bias. Performance evaluation scores were assigned at the start of each performance cycle (i.e., year) and represent the perceived ability of the agents by the organizations in the simulation. First, job performance of the agents was calculated which averages how well agents perform their traditional job duties and how they develop their performance based on developmental opportunities. Performance of normal job duties was sampled from an average of two values: an agent's yearly ability, drawn from a normal distribution with M = an agent's task ability (sampled previously), and an agent's gender-by-position score. The gender-by-position score was designed to model preference for (a) males and (b) line experience when making promotion

decisions. Each individual throughout the simulation was assigned a gender score (i.e., 0-4) and a position score (i.e., 0-4) based on their gender and position in the organization. These two scores were combined to create the gender-by-position score, which was added to an individual's average task ability and used to sample performance on normal job duties. See Table 7 for exact gender-by-position score assignments.

Table 7
Bias Values for Gender and Line/Staff Positions by Simulation Condition.

Simulation Condition	Gender		Position		Gender-by-Position Score			
	Male	Female	Line	Staff	Male/ line	Female/ line	Male /staff	Female /staff
No Bias	1	1	1	1	2	2	2	2
Low Bias	3	1	3	1	6	4	4	2
High Bias	4	0	4	0	8	4	4	0

Agents selected to take leave in a given year also experienced a point reduction in performance evaluation scores to model bias against agents taking leave in a given year (Judiesch & Lyness, 1999). The amount of points added to or removed from performance appraisal evaluations of men and women was selected based on the product of (a) the variance in job performance for the year

and (b) the variance in job performance selected specifically based on simulation condition and gender. These values will be subtracted from female job performance to model the motherhood penalty and will be added to male job performance to model bonus males receive once returning to work after having children (Hodges & Budig, 2010). See Table 8 for exact variance in performance evaluation for males and females taking leave based on leave by gender parameters.

Table 8
Variance in Performance Evaluation Bias for Having Children.

	Variance in performance evaluations	
Simulation Condition	Males	Females
No Bias	0	0
Low Bias	.03	.07
High Bias	.03	.10

Differences in Opportunities. Males and females experience differences in developmental opportunities presented within organizations such that males are given more opportunities to contribute meaningfully at work and receive more feedback on their performance (Women in the Workplace, 2016). Based on this notion, individuals were assigned opportunity seeking propensities and opportunity presentation values, both drawn from a normal distribution with M =

6 developmental opportunities sought and available in a given year. The value of six developmental opportunities was based on previous OGS simulations offering agents a 50% chance of being presented with a developmental opportunity each month in a given year (Samuelson et al., 2018). Males received either 0, 3, or 5 bias points added to the mean of their opportunity seeking propensities, and the mean of the opportunities presented to them depending on the simulation condition to model the increased amount of opportunities/feedback both sought by and provided to males. See Table 9 for exact bias points added to male opportunity seeking and opportunity presentation by simulation condition.

Table 9
Bias Added to Male Opportunity Seeking and Opportunity Presentation by Simulation Run.

	Males	
Simulation condition	Opportunity Seeking	Opportunity Presentation
No Bias	0	0
Low Bias	3	3
High Bias	5	5

To model differences in the value of opportunities presented to males and females, developmental opportunities taken by individuals were selected based on changing values for gender and simulation condition. See Table 10 for exact values used for developmental opportunities by gender and condition.

Table 10
Value of Developmental Opportunities Provided to Males and Females.

	Value given to developmental opportunities	
Simulation condition	Males	Females
No Bias	1	1
Low Bias	1	.50
High Bias	1.2	.30

Additionally, the simulations kept track of how long an agent remains at a given organizational level to model increased likelihood of turnover due to lack of developmental opportunities (i.e., being passed over multiple times for promotions signals an individual is not suitable for future promotions, thus lowering their chances of being considered for future promotions; Martell et al., 2012; Robison-Cox et al., 2007). If an agent was promoted in a given year, level tenure was reset to zero. If an agent was not promoted, level tenure was increased by one year. When an agent's level tenure exceeded 4 years, he or she had an increased probability (i.e., 40%) of voluntarily leaving the organization.

Virtual Experiment 2

Independent Variables (HR Initiatives). The HR initiatives in Virtual Experiment 2 (VE2) altered the model parameters investigated in VE1 with the goal of reducing OGS and increasing organizational workforce potential. The first bundle of HR initiatives (Combating Bias) targeted the parameters that influence bias in selection and performance evaluation. The second bundle of HR initiatives (Equal Opportunities) targeted the parameters that influence differences in how developmental opportunities are sought and presented by females, as well as the

likelihood that agents would not return to work after having children. The final bundle of HR initiatives (Even the Playing Field) targeted the parameters that assign males and females to line and staff positions.

Bundle 1: Combating bias. This bundle captured how biased evaluation of females impacts career advancement. First, females experience bias in selection procedures which harms their chances of being selected into managerial careers. Additionally, females experience bias in performance evaluation where individuals make decisions about the competence of women in their jobs. Performance evaluation ratings consequently have implications for which individuals are promoted in an organization. Within the simulation, this bundle equalized the proportion of females selected from the external labor pool by setting a parameter to hire males and females at equal rates (*reducing selection bias*). This bundle also removed the bias in performance evaluations. As a result, females were not evaluated more negatively than men for taking leave, and their gender-by-position scores were equalized. Performance evaluation scores became their true score as opposed to their perceived ability scores (*reducing performance appraisal evaluation bias*). Bias in promotion rates of males and females was reduced as a result of eliminating bias in performance evaluation scores for females.

Bundle 2: Equal opportunities. This second bundle of HR initiatives was designed to remove barriers females experience throughout their careers. This bundle consisted of providing equal opportunities for development to males and females in addition to providing constructive feedback through performance

management to address differences in training and developmental opportunities. This mechanism removed the bias favoring males in the presentation of developmental opportunities. In addition, this initiative set opportunity seeking propensities of males and females to be equal, on average, to model how encouraging women to ask for opportunities at similar rates to men helps increase developmental opportunities presented to agents. This bundle also modeled implementing parental leave policies that entice females to return to work after conceiving children to address familial effects females experience. Within the model, a small proportion of females selected to conceive children in a given year voluntarily left the organization. With this HR initiative, males and females left the organization due to taking parental leave at equal rates.

Bundle 3: Even the playing field. The underlying theme of this bundle is to encourage females to pursue managerial careers and to remain in them. This bundle laid a foundation for decreasing OGS by bringing more females into careers that set them up for leadership paths initially. This bundle modeled the act of organizations attracting a more diverse job candidate pool and helping females recognize their full potential in managerial careers. Within the model, females were equally represented in line positions throughout their lifespan in the organization, both in the internal and external labor pools. Tables 11-17 show how the parameters were altered for each simulated bundle.

Table 11
Proportions of Females in Line Positions by Simulation Run and Organizational Level.

	Organizational Level

Simulation condition	1	2	3	4	5	6
Bundle 1	.25	.35	.40	.45	.45	.50
Bundle 2	.25	.35	.40	.45	.45	.50
Bundle 3	.50	.50	.50	.50	.50	.50

Table 12
Proportion of Males and Females Taking Parental Leave, and Subsequently Leaving an Organization.

Simulation Condition	Proportion taking leave		Probability of turnover resulting from taking leave	
	Male	Female	Male	Female
Bundle 1	.11	.15	.15	.30
Bundle 2	.11	.15	.15	.30
Bundle 3	.11	.15	.15	.15

Table 13
Selection Probabilities of Females by Simulation Run and Organizational Level.

	Organizational Level					
Simulation condition	1	2	3	4	5	6
Bundle 1	.50	.50	.50	.50	.50	.50
Bundle 2	.25	.35	.40	.45	.45	.50
Bundle 3	.25	.35	.40	.45	.45	.50

Table 14
Biases for Gender and Line/Staff Positions.

Simulation Condition	Gender		Position		Gender-by-Position Score			
	Male	Female	Line	Staff	Male/ line	Female/ line	Male /staff	Female/ staff
Bundle 1	1	1	1	1	2	2	2	2
Bundle 2	3	1	3	1	6	4	4	2
Bundle 3	3	1	3	1	6	4	4	2

Table 15
Variance in Performance Evaluation for Taking Parental Leave.

	Variance in performance evaluations	
Simulation condition	Males	Females
Bundle 1	0	0
Low Bias	.03	.07
High Bias	.03	.07

Table 16
Bias Added to Male Opportunity Seeking and Opportunity Presentation by Simulation Condition.

	Males	
Simulation condition	Opportunity Seeking	Opportunity Presentation
Bundle 1	3	3
Bundle 2	0	0
Bundle 3	3	3

Table 17

Difference in Values Given to Developmental Opportunities of Males and Females by Simulation Condition and Gender.

	Value given to developmental opportunities	
Simulation condition	Males	Females
Bundle 1	1	.50
Bundle 2	1	1
Bundle 3	1	.50

Dependent Variables

The outcomes of interest for both VE1 and VE2 were OGS and organizational workforce potential. The model served to examine how OGS dynamically manifests in organizations and how OGS impacts organizational workforce potential.

Organizational Gender Stratification. OGS was calculated as the average proportion of males and females present in each organizational level in each year across 1,000 simulated organizations.

Organizational Workforce Potential. Organizational workforce potential was calculated in two ways. Previous research states that aggregation of employee knowledge, skills, and abilities contribute to a firm's performance due to human capital resources accumulation (Ployhart & Moliterno, 2011). True organizational performance was calculated as the average of all employees' true job performance by level across 1,000 simulated organizations. Perceived organizational performance was calculated based on performance evaluations of the agents by level across 1,000 simulated organizations. This modeled how perceptions of

individual performance based on biased evaluations influence the view of overall organizational workforce potential. These two values are compared to examine how well an organization thinks it is doing (perceived organizational performance) compared to how well an organization is actually doing (true organizational performance). If organizations are promoting individuals based on perceived performance rather than true performance, and perceived performance favors males irrespective of true performance, then organizations are not promoting their best talent, and thus, are underperforming.

Simulation Algorithm Description

Both VE1 and VE2 followed the same simulation algorithm. The difference between the virtual experiments is seen in the alteration of the model parameters. The following section provides an outline of each step in the simulation. Within each step, the parameters discussed varied depending on (a) the virtual experiment being conducted and (b) the conditions within the virtual experiments. Table 18 provides a general pseudo-code for the present model, and Figure 1 provides a visual of the present simulation procedure. Additionally, the simulation steps are listed below:

1. Model parameters were set initially. Model parameters included:
    - Organizational life-cycle set to 40 years.
    - The base number of opportunities available in a given year;
    - Bias values for opportunity seeking, opportunities presented, and gender and position values;
    - Selection probabilities of females;

- Proportion of males and females taking leave in a given year;
- Variance in performance evaluations for individuals taking leave in a given year;
- Proportion of individuals taking leave that voluntarily turnover;
- Probability of voluntary turnover based on organizational level tenure.
- For VE1, these values are altered to examine their individual and combinatorial effects; for VE2, these values are equalized for males and females depending on the HR initiative being examined to model the implementation of various HR initiatives.

2. An organization is created, consisting of six levels (C-suite, SVP, VP, Senior Manager, Manager, and Entry Level) split into 50% line and 50% staff positions containing 11,490 employees total.
3. The organization is filled with individuals occupying line and staff positions. Individuals are assigned individual characteristics, including gender, ability, leadership potential, age, and retirement age.
4. The simulation begins with an incrementation in the time clock (*year*) to $year = year + 1$.

5. Individuals are assigned a gender score, a position score, and a gender-by-position score.
6. Leadership potential is computed for each individual.
7. Developmental opportunities presented and taken by individuals is selected for the year. The opportunities taken are assigned a value depending on gender.
8. Performance on normal job duties and developmental opportunities taken is computed. Performance evaluations are conducted.
9. Proportion of males and females taking leave in a given year is sampled. Leave bias is computed and added/subtracted to performance evaluation scores.
10. Simulation outputs are calculated: count of males and females, true job performance and perceived job performance by organizational level and gender.
11. Agent age and level tenure are increased by one year.
12. The voluntary turnover mechanism is enacted, which consists of four reasons for voluntarily leaving the organization: reaching retirement age (as sampled previously), organizational level tenure exceeding 4 years, probability of leaving after having children, and leaving at random (set to 4% of the workforce).
13. The involuntary turnover mechanism, adapted from Scullen et al., (2005), is enacted in which the lowest 10% of agents in terms of perceived performance are removed.

14. The number of external hires is selected based on the proportion of external hires at each level set initially. An external labor pool is created based on the number of external hires selected. Individuals in the external labor pool fill the organization with pre-sampled individual characteristics (the same mechanism used to initially fill the organization).
15. The promotion mechanism, in which individuals in the organization will be ranked and ordered by level and performance evaluation scores, is enacted. The simulation iterates over each organizational level and selects the individuals in the organizational level below that of the current iteration with the highest performance based on how many remaining vacancies there are after external hiring is completed.
16. The remaining vacant positions in the lowest level (level 6) of the organization are filled with external hires.
17. The simulation continues to run through steps 4-16 when the time, *year*, is less than the simulation duration initially determined (i.e., 40 years). When *year* is greater than the simulation duration, the simulation will end.

Table 18
Pseudo-code for Computational Model of Organizational Gender Stratification.

Step	Action
1	Set model parameters
2	Create organization
3	Fill organization with agents
4	Increment time clock: *year* = *year* + 1
5	Assign gender, position, and gender-by-position scores

6	Compute leadership potential
7	Enact developmental opportunity seeking and presentation mechanisms
8	Calculate true performance and perceived performance of agents
9	Sample individuals taking leave for the year; update perceived performance scores
10	Calculate organizational gender stratification and performance
11	Increase agent age and level tenure
12	Enact voluntary turnover mechanism
13	Enact involuntary turnover mechanism
14	Select number of external hires; fill organization vacancies with external hires
15	Enact promotion mechanism
16	Fill remaining vacant positions in level six with external hires
17	If *year* $\leq$ 40, go to Step 4 If *year* > 40, end simulation

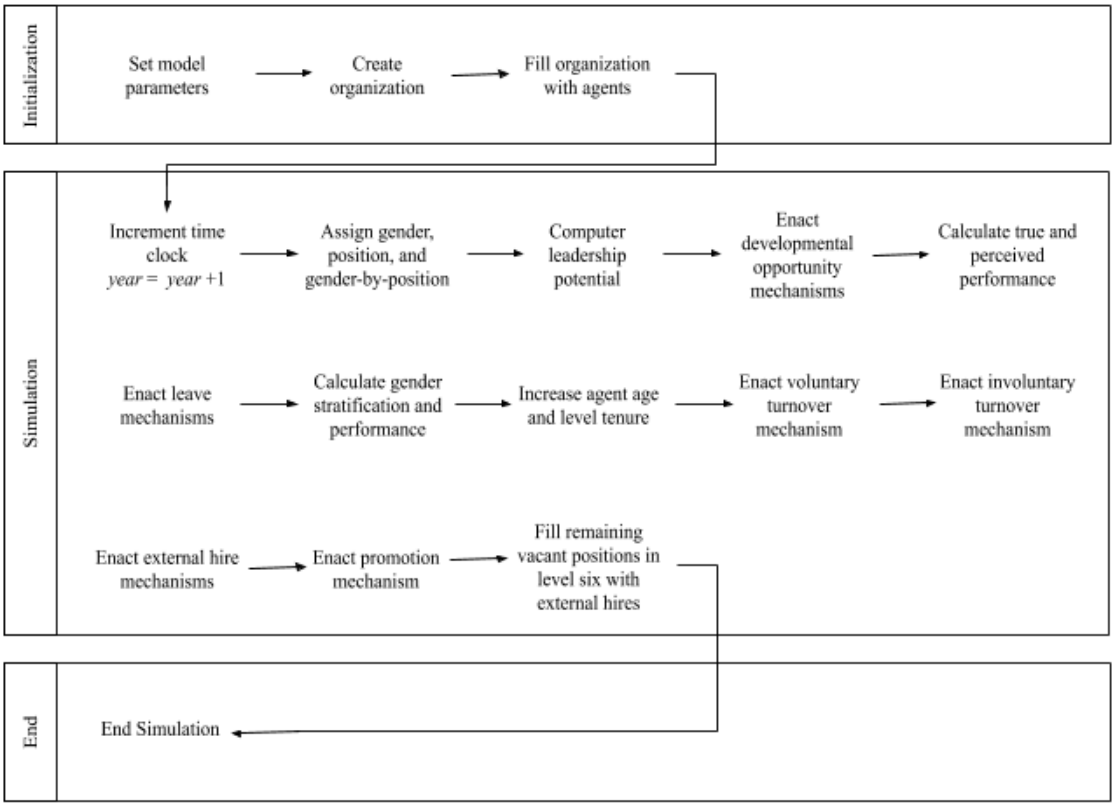

Figure 1. Simulation Procedure Diagram.

It is worth noting that there are assumptions inherent in computational modeling. The present model consists of three primary assumptions: 1) model

parameters were set based on subjective interpretation of previous research; 2) the sequential nature of sampling procedures used in the simulation create within-person variability; 3) bias values are static in the model. See Table 19 for a detailed explanation of the model assumptions.

Table 19
Computational Model Table of Assumptions.

1. Agent ability, leadership ability, age, retirement age, and opportunity seeking are sampled from normal distributions.
2. There is a 50/50 split of line and staff positions within an organization at all times.
3. Normal job duty performance is sampled from a normal distribution using static bias points added to an individual agent's sampling mean.
4. Bias points added to an agent's sampling distribution mean for performance are static values based on points awarded for gender and position.
5. Developmental opportunity performance is sampled X times for a given individual, with X = an agent's developmental opportunities taken.
6. Perceived job performance is operationalized as the average of an agent's normal job duty performance and developmental opportunity performance.
7. True job performance is operationalized as an agent's true ability, previously sampled.
8 A forced ranking distribution system removes agents with perceived performance evaluation scores lower than the 10^{th} percentile for a given level.
9. In any given year, agents are sampled to leave voluntarily based on parental leave, retirement, tenure in level, or at random.

Results

This study utilized two virtual experiments to understand the process of OGS and examine potential organizational interventions to reduce OGS. The primary outcomes recorded in the virtual experiments were (1) OGS (i.e., the proportion of males and females in each organizational level), (2) true organizational performance (i.e., true ability of agents), and (3) perceived organizational performance (i.e., perceived ability of agents influenced by biases). Analyses were conducted in two phases - one for each virtual experiment. A

hierarchically-structured organization was initialized for each simulation containing individuals with varying characteristics, including gender, age, retirement age, ability, and leadership quality, to explore the research propositions and questions. The first virtual experiment consisted of three conditions (i.e., no bias, low bias, and high bias) to explore the theoretical space of the OGS model parameters (i.e., OGS factors), and the second virtual experiment examined the effectiveness of three bundles of HR initiatives designed to combat factors leading to OGS (i.e., combating bias, equal opportunities, and evening the playing field). Each of six simulations had time (*T*) set to 40 years and ran for 1,000 iterations for a total of 240,000 simulated organizational years. Results were aggregated across all 1,000 organizations for each of the simulated conditions.

Virtual Experiment 1

The first phase of analyses assessed Propositions I and II, that over time, (1) OGS will occur most severely in the upper levels of the organization, and (2) perceived organizational performance will be higher than true organizational performance in the presence of OGS. The average proportion of males and females in each level of the organization was examined for each of the simulated conditions (no bias, low bias, and high bias). Findings revealed that under no bias (i.e., in a perfectly gender-balanced organization), OGS does not occur in any organizational level, as depicted by equal proportions of males and females over time. The proportion of males and females across levels and conditions is presented in Table 20, and visualized in Figure 2. In years 1, 5, 10, and 15, the proportions of females in level one (C-Suite) of the organization in the no bias

condition were .50, .50, .50, and .49, respectively. In the low bias conditions, over time, deviations in the proportion of males and females in each level increase such that males increasingly occupy more positions in all organizational levels, and this effect is especially pronounced in the upper levels (i.e., levels one through three) of the organization. In years 1, 5, 10, and 15, the proportions of females in level one of the organization in the low bias condition were .50, .34, .19, and .15, respectively. A similar pattern was found for the high bias condition such that the proportion of males in each level increased over time, especially within the upper level of the organization. In years 1, 5, 10, and 15, the proportions of females in level one of the organization in the high bias condition were .50, .28, .08, and .05, respectively. Across the three conditions (no bias, low bias, high bias), OGS occurs strongest under high bias (women occupying 5% of C-suite positions), followed by low bias (women occupying 15% of C-suite positions), and no bias (women occupying 49% of C-suite positions).

To assess Proposition I, OGS at each organizational level across conditions was compared. Given OGS did not emerge in the condition without bias, Proposition I was assessed with respect to the low bias and high bias condition results. Within both the low bias and high bias conditions, the proportion of females lessens with each increase in organizational level. Under low bias for levels one (C-suite) through six (Entry Level), females occupied 15%, 26%, 34%, 38%, 42% and 48% of positions, respectively. Under high bias, females occupied 5%, 11%, 23%, 30%, 39%, and 48% of positions, respectively. These results support Proposition I such that over time, OGS occurred most

severely in the upper levels of the organization. Biases against females have minimal impact at the Entry Level, and their impact increases with each organizational level. The biases have the strongest effects in the upper levels of the organization.

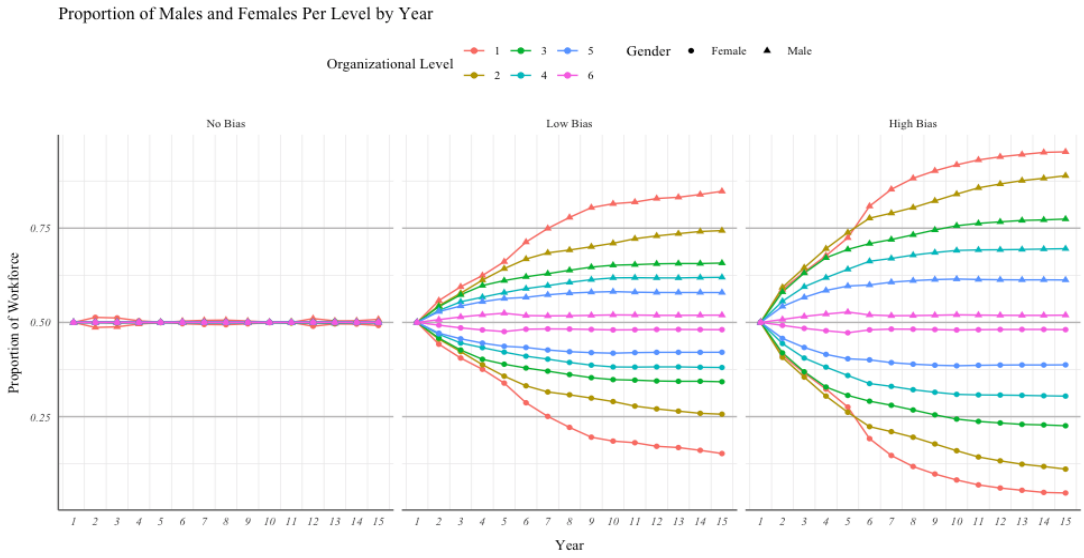

Figure 2. Gender Stratification Across Time and Organizational Level for No Bias, Low Bias, and High Bias Conditions. Visualizations truncated at 15 year due to patterns plateauing.

Table 20

Proportion of Males and Females in Organizational Level 1 and 6 for Years 1, 5, 10 and 15 for No Bias, Low Bias, and High Bias.

Organizational Level	Condition	Gender	1	5	10	15
C-suite (Level 1)	No Bias	Female	0.50	0.50	0.50	0.49
			[.50, .50]	[.17, .83]	[.17, .83]	[.17, .83]
C-suite (Level 1)	No Bias	Male	0.50	0.50	0.50	0.51
			[.50, .50]	[.17, .83]	[.17, .83]	[.17, .83]
C-suite (Level 1)	Low Bias	Female	0.50	0.34	0.19	0.15

			[.50, .50]	[0, .67]	[0, .50]	[0, .50]
C-suite (Level 1)	Low Bias	Male	0.50	0.66	0.81	0.85
			[.50, .50]	[.33, 1]	[.50, 1]	[.50, 1]
C-suite (Level 1)	High Bias	Female	0.50	0.28	0.08	0.05
			[.50, .50]	[0, .67]	[0, .33]	[0, .33]
	High Bias	Male	0.50	0.72	0.92	0.95
C-suite (Level 1)			[.50, .50]	[.33, 1]	[.67, 1]	[.67, 1]
Entry Level (Level 6)	No Bias	Female	0.50	0.50	0.50	0.50
			[.50, .50]	[.49, .51]	[.49, .51]	[.49, .51]
Entry Level (Level 6)	No Bias	Male	0.50	0.50	0.50	0.50
			[.50, .50]	[.49, .51]	[.49, .51]	[.49, .51]
Entry Level (Level 6)	Low Bias	Female	0.50	0.48	0.48	0.48
			[.50, .50]	[.47, .49]	[.47, .49]	[.47, .49]
Entry Level (Level 6)	Low Bias	Male	0.50	0.52	0.52	0.52
			[.50, .50]	[.51, .53]	[.51, .53]	[.51, .53]
Entry Level (Level 6)	High Bias	Female	0.50	0.47	0.48	0.48
			[.50, .50]	[.46, .48]	[.47, .49]	[.47, .49]
Entry Level (Level 6)	High Bias	Male	0.50	0.53	0.52	0.52
			[.50, .50]	[.52, .54]	[.51, .53]	[.51, .53]

Note: values within cells represent the average proportion of individuals (i.e., males or females) occupying levels 1 or 6 in a given year (i.e., year 1, 5, 10, or 15). Bracketed values represent confidence intervals for the average proportion of individuals across 1,000 organizational simulations.

To assess Proposition II, the average perceived and true performance of males and females in each level of the organization was examined for each of the simulated conditions. Results from the present study show that under no bias, the perceived performance of males and females is approximately equal at all levels across time. To demonstrate this result, the following values represent mean perceived performance for females and males in levels one (C-suite) through six (Entry Level) for year 15 under no bias, respectively: F = 128.79, M = 128.83; F = 128.09, M = 128.13; F = 124.73, M = 124.72; F = 118.45, M = 118.47; F = 109.92, M = 109.92; F = 99.46, M = 99.45. Under low bias, there are deviations in perceived performance for males and females. The following values represent mean perceived performance for females and males in levels one through six for year 15 under low bias, respectively: F = 127.87 M = 130.63; F = 127.75, M = 129.57; F = 124.84, M = 125.90; F = 118.68, M = 119.50; F = 110.14, M = 110.95; F = 99.57, M = 100.72. These values show that not only are males perceived to be performing at higher levels than females, but these biased perceptions grow stronger with each organizational level. High bias results show a similar, yet stronger pattern such that the perceived performance for females and males in levels one through six for year 15 under high bias are as follows: F = 127.21, M = 131.14; F = 127.33, M = 130.19; F = 124.79, M = 126.40; F = 118.62, M = 119.86; F = 109.95, M = 111.24; F = 99.21, M = 101.06. Again, these values show that men are perceived to be performing at a higher level than females throughout the organization, and the differences are larger with each increasing organizational level (see Table 21 for a summary of perceived

performance means in year 15 for males and females, and Figure 3 for a visualization of gender differences in perceived performance over time). Overall, when either low or high bias is present in an organization, males are perceived to be performing at a higher level than females throughout the organization.

Results from the present study also show that under no bias, the true performance of males and females is approximately equal at all levels across time. To demonstrate this result, the following values represent mean true performance for males and females in levels one (C-suite) through six (Entry Level) for year 15, respectively: $F = 127.78$, $M = 127.82$; $F = 127.10$, $M = 127.10$; $F = 123.73$, $M = 123.74$; $F = 117.45$, $M = 117.47$; $F = 108.92$, $M = 108.92$; $F = 98.46$, $M = 98.45$. Under low bias, there are slight deviations in true performance for females and males in levels one through six for year 15: $F = 127.49$, $M = 127.76$; $F = 127.23$, $M = 126.77$; $F = 124.31$, $M = 123.10$; $F = 118.13$, $M = 116.70$; $F = 109.60$, $M = 108.14$; $F = 99.02$, $M = 97.91$. Under low bias, in all levels excluding level one (C-suite), the true performance of females exceeds the true performance of males, which is in direct opposition of perceived performance results. Under high bias, there are similar deviations in true performance for females and males in levels one through six for year 15: $F = 126.88$, $M = 127.70$; $F = 127.49$, $M = 126.72$; $F = 124.88$, $M = 122.93$; $F = 118.69$, $M = 116.39$; $F = 110.01$, $M = 107.77$; $F = 99.24$, $M = 97.62$. Under high bias, in all levels excluding level one (C-suite), the true performance of females exceeds the true performance of males, which is also in direct opposition of perceived performance results (see Table 21 for a summary of true performance means in year 15 for males and females, and

Figure 4 for a visualization of gender differences in true performance over time). Overall, within the low bias and high bias conditions, females had higher true performance compared to males throughout the organization, excluding in the C-suite.

Table 21
Average True Performance and Perceived Performance Across Levels in Year 15 for Low Bias and High Bias Conditions.

		Low Bias		High Bias	
Org Level	Gender	True Performance Mean	Perceived Performance Mean	True Performance Mean	Perceived Performance Mean
C-suite (Level 1)	Female	127.49	127.87	126.88	127.21
		[117.17, 129.95]	[115.88, 135]	[112.99, 129.94]	[109.05, 134.99]
C-suite (Level 1)	Male	127.76	130.63	127.70	131.14
		[124.58, 129.31]	[126.47, 133.75]	[124.71, 129.30]	[127.54, 134]
SVP (Level 2)	Female	127.23	127.75	127.49	127.33
		[124.56, 128.76]	[124.17, 130.82]	[122.65, 129.40]	[120.87, 132.52]
SVP (Level 2)	Male	126.77	129.57	126.72	130.19
		[125.28, 127.73]	[127.96, 131.01]	[125.60, 127.67]	[128.82, 131.66]
VP (Level 3)	Female	124.31	124.84	124.88	124.79
		[123.45, 125.15]	[123.73, 126]	[123.93, 125.77]	[123.59, 127.19]
VP (Level 3)	Male	123.10	125.90	122.93	126.40

		[122.43, 123.76]	[125.07, 126.69]	[122.23, 123.60]	[125.59, 127.19]
Senior Manager (Level 4)	Female	118.13	118.68	118.69	118.62
		[117.64, 118.67]	[118.05, 119.34]	[118.19, 119.23]	[117.90, 119.33]
Senior Manager (Level 4)	Male	116.70	119.50	116.39	119.86
		[116.26, 117.12]	[119, 120.01]	[115.97, 116.81]	[119.38, 120.34]
Manager (Level 5)	Female	109.60	110.14	110.01	109.95
		[109.32, 109.87]	[109.81, 110.48]	[109.74, 110.32]	[109.58, 110.34]
Manager (Level 5)	Male	108.14	110.95	107.77	111.24
		[108.88, 108.41]	[110.67, 111.22]	[107.53, 108.05]	[110.96, 115.54]
Entry Level (Level 6)	Female	99.02	99.57	99.24	99.21
		[98.76, 99.30]	[99.27, 99.88]	[98.99, 99.49]	[98.91, 99.49]
Entry Level (Level 6)	Male	97.91	100.72	97.62	101.06
		[97.67, 98.17]	[100.46, 100.98]	[97.37, 97.88]	[100.80, 101.34]

Note: values within cells represent the average performance of individuals (i.e., males or females) occupying levels 1 or 6 in a given year (i.e., year 1, 5, 10, or 15). Bracketed values represent confidence intervals for the average performance of individuals across 1,000 organizational simulations. *Org* = organizational.

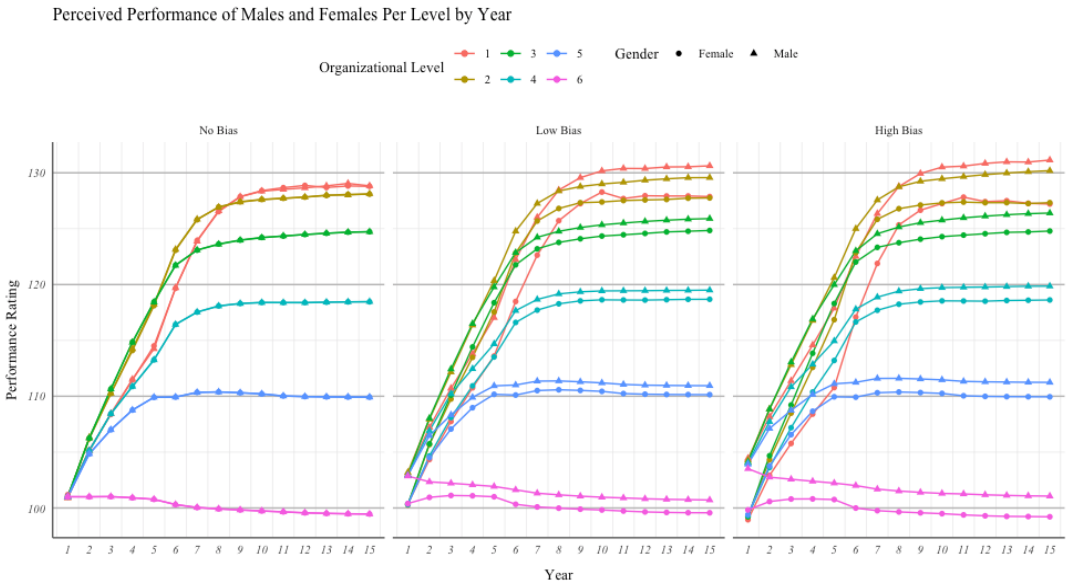

Figure 3. Perceived Performance Across Time and Organizational Level for No Bias, Low Bias, and High Bias Conditions.

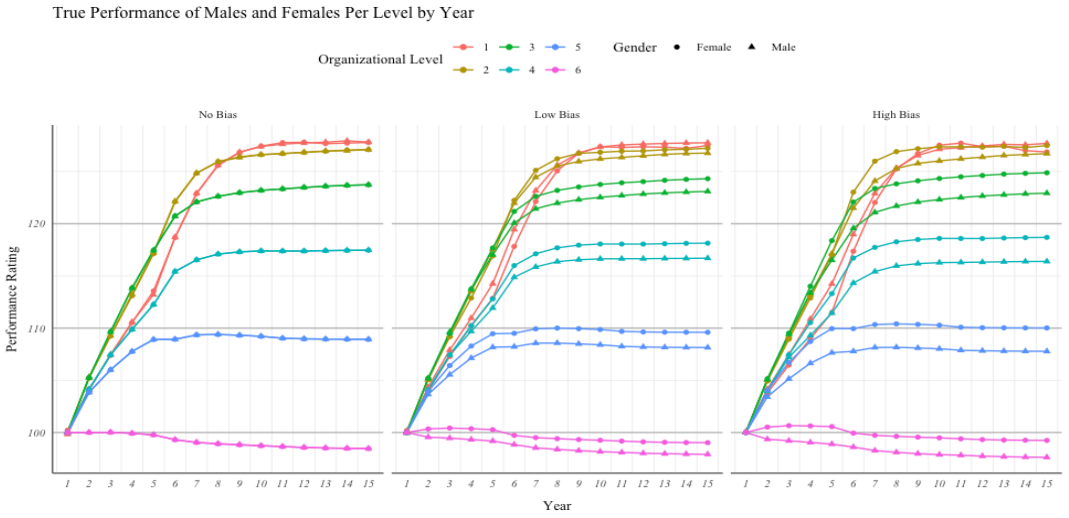

Figure 4. True Performance Across Time and Organizational Level for No Bias, Low Bias, and High Bias Conditions.

These results provide support for Proposition II such that perceived organizational performance was higher than true organizational performance in the presence of OGS at all levels across gender. Across all three conditions, differences between true and perceived performance are strongest when high bias

is present, followed by low bias, and no bias (see Table 22 for exact values). In the no bias condition, mean differences for true and perceived performance across gender by level (one through six) are as follows: $M_{difference}$ = 1.01, $M_{difference}$ = 1.01, $M_{difference}$ = 1.00, $M_{difference}$ = 1.00, $M_{difference}$ = 1.00, $M_{difference}$ = 1.00, and $M_{difference}$ = 1.00, all favoring perceived performance. In the low bias condition, mean differences for true and perceived performance across gender by level (one through six) are as follows: $M_{difference}$ = 1.91, $M_{difference}$ = 1.66, $M_{difference}$ = 1.67, $M_{difference}$ = 1.67, $M_{difference}$ = 1.68, and $M_{difference}$ = 1.68, favoring perceived performance. In the high bias condition, mean differences for true and perceived performance across gender by level (one through six) are as follows: $M_{difference}$ = 2.82, $M_{difference}$ = 1.67, $M_{difference}$ = 1.69, $M_{difference}$ = 1.70, $M_{difference}$ = 1.70, and $M_{difference}$ = 1.71, favoring perceived performance. The difference between true and perceived performance is strongest in level one (the C-suite) of an organization across all three conditions. When averaging across gender and organizational levels, the overall differences in performance between true and perceived organizational performance were $M_{difference}$ = 1.00, $M_{difference}$ = 1.66, and $M_{difference}$ = 1.72 favoring perceived performance under no bias, low bias, and high bias, respectively (shown in Table 23). Overall, these results show that organizational workforce potential is maximized under no bias and reduced under low and high bias. In other words, when OGS is minimized, the true performance of individuals more closely resembles the perceived performance of the same individuals, which enhances organizational workforce potential.

Table 22
True and Perceived Performance Across Levels by Condition for Year 15.

Condition	Organizational Level	True Performance Mean	Perceived Performance Mean	Difference
No Bias	C-suite (Level 1)	127.80	128.81	1.01
	SVP (Level 2)	127.10	128.11	1.01
	VP (Level 3)	123.73	124.73	1.00
	Senior Manager (Level 4)	117.46	118.46	1.00
	Manager (Level 5)	108.92	109.92	1.00
	Entry Level (Level 6)	98.46	99.46	1.00
Low Bias	C-suite (Level 1)	127.65	129.56	1.91
	SVP (Level 2)	127.00	128.66	1.66
	VP (Level 3)	123.70	125.37	1.67
	Senior Manager (Level 4)	117.42	119.09	1.67
	Manager (Level 5)	108.87	110.54	1.68
	Entry Level (Level 6)	98.46	100.14	1.68
High Bias	C-suite (Level 1)	127.53	130.35	2.82
	SVP (Level 2)	127.10	128.77	1.67

VP (Level 3)	123.91	125.59	1.69
Senior Manager (Level 4)	117.54	119.24	1.70
Manager (Level 5)	108.89	110.60	1.70
Entry Level (Level 6)	98.43	100.14	1.71

Table 23
Average True, and Perceived Organizational Performance for No Bias, Low Bias, and High Bias in Year 15.

Condition	Overall True Organizational Performance	Overall Perceived Organizational Performance	Overall Difference Between True and Perceived Organizational Performance
No Bias	117.25	118.25	1.00
Low Bias	117.18	118.84	1.66
High Bias	117.19	118.92	1.72

It is worth noting that in the C-suite of the organizations within each simulated condition, true performance of females did not exceed true performance of males. There are two explanations for this unexpected pattern. Both explanations are rooted in the sampling procedures used in the present model. The

first explanation relates to external hiring processes: the C-suite of all simulated organizations in the present model consists of six employees. When a position in the C-suite is vacant, a probability of external hire is sampled. If that sampled probability favors external hiring, then a new agent is created with a sampled gender and true performance ability. The true performance ability of agents in the C-suite was drawn from a normal distribution with $M = 100$, $SD = 15$ (see Methods for more details). It is probable that during a number of simulation runs, a female agent was created with sub-average ability, compared to the average ability in the C-suite, and placed into the C-suite. Due to the low number of females present in the C-suite (i.e., typically only one out of six), it is possible that the sampled external hire of a female with sub-average ability into the C-suite occurred within the simulations to bring down the average of female true ability within an organization. The second explanation relates to the calculation of perceived performance in the organization. Perceived performance is the average of an agent's sampled normal job duty performance and developmental opportunity performance, both of which are sampled based on a) an agent's true ability and b) incorporated biases depending on the condition (see Methods for a detailed explanation). Perceived performance of agents fluctuates year to year due: 1) the variance inherent in sampling procedures; 2) the number of developmental opportunities an agent takes; 3) being in a line or staff position; 4) gender. It is possible that during this sampling, females receive higher perceived performance evaluations than their true performance as a result of these reasons, which allows perceived performance to be higher than true performance in one

year and lower than true performance in another year, allowing lower-ability agents to be promoted into the C-suite.

Virtual Experiment 2

The second phase of analysis assessed Research Questions (RQs) I-III: how and to what extent is OGS reduced and organizational workforce potential increased as a result of (I) reducing biases in selection and performance appraisal, (II) providing equal developmental opportunities to males and females and providing improved parental leave policies to employees, and (III) placing more women in line positions compared to staff positions. The baseline conditions used for VE2 were the low bias condition parameters set in VE1 since the results of VE1 most closely resembled what is seen in organizations today (i.e., approximately 80% males occupying upper level leadership positions; Women in the Workplace, 2017).

The three HR bundles were evaluated in relation to OGS, perceived performance, and true performance (i.e., same outcomes measured in VE1). In examining the effectiveness of the HR bundles in reducing OGS, results show that Bundle 1 (removing bias in selection and performance appraisal) is the most effective at reducing OGS compared to Bundles 2 and 3. The proportion of females in organizational levels one (C-suite) through six (Entry Level) under Bundle 1 in year 15 were 0.46, 0.46, 0.46, 0.47, 0.47, and 0.48, respectively (for reference, under no bias in VE1, the proportion of females in the C-suite after 15 years was 0.49). The proportion of females in organizational levels one through six under Bundle 2 (equalizing developmental opportunities and providing

improved parental leave) were 0.16, 0.27, 0.36, 0.40, 0.44, and 0.49, respectively. For Bundle 3 (equalizing the proportion of males and females in line positions), the proportion of females occupying levels one through six were 0.16, 0.26, 0.34, 0.38, 0.42, and 0.48, respectively, for Bundle 3. Table 24 shows the proportion of males and females across organizational level in year 15 for Bundles 1, 2, and 3. Overall, Bundle 1 was more effective at reducing OGS than both Bundle 2 and Bundle 3 (see Figure 5 for a visualization of the emergence of OGS over time across the three bundles).

Table 24
Proportion of Males and Females Across Organizational Level in Year 15 for Bundles 1, 2, and 3.

		Bundle 1	Bundle 2	Bundle 3
Organizational Level	Gender	Proportion		
C-suite (Level 1)	Female	0.46	0.16	0.16
		[.17, .83]	[0, .50]	[0, .50]
C-suite (Level 1)	Male	0.54	0.84	0.84
		[.17, .83]	[.50, 1]	[.50, 1]
SVP (Level 2)	Female	0.46	0.27	0.26
		[.31, .64]	[.14, .42]	[.14, .42]
SVP (Level 2)	Male	0.54	0.73	0.74
		[.36, .69]	[.58, .86]	[.58, .86]

VP (Level 3)	Female	0.46	0.36	0.34
		[.40, .53]	[.31, .43]	[.28, .41]
VP (Level 3)	Male	0.54	0.64	0.66
		[.47, .60]	[.57, .69]	[.59, .72]
Senior Manager (Level 4)	Female	0.47	0.40	0.38
		[.43, .50]	[.37, .43]	[.35, .41]
Senior Manager (Level 4)	Male	0.53	0.60	0.62
		[.50, .57]	[.57, .63]	[.59, .65]
Manager (Level 5)	Female	0.47	0.44	0.42
		[.46, .49]	[.42, .45]	[.40, .44]
Manager (Level 5)	Male	0.53	0.56	0.58
		[.51, .54]	[.55, .58]	[.56, .60]
Entry Level (Level 6)	Female	0.48	0.49	0.48
		[.47, .49]	[.48, .50]	[.47, .49]
Entry Level (Level 6)	Male	0.52	0.51	0.52
		[.51., .53]	[.50, .52]	[.51, .53]

Note: values within cells represent the average proportion of individuals (i.e., males or females) occupying levels 1 or 6 in year 15. Bracketed values represent confidence intervals for the average proportion of individuals across 1,000 organizational simulations.

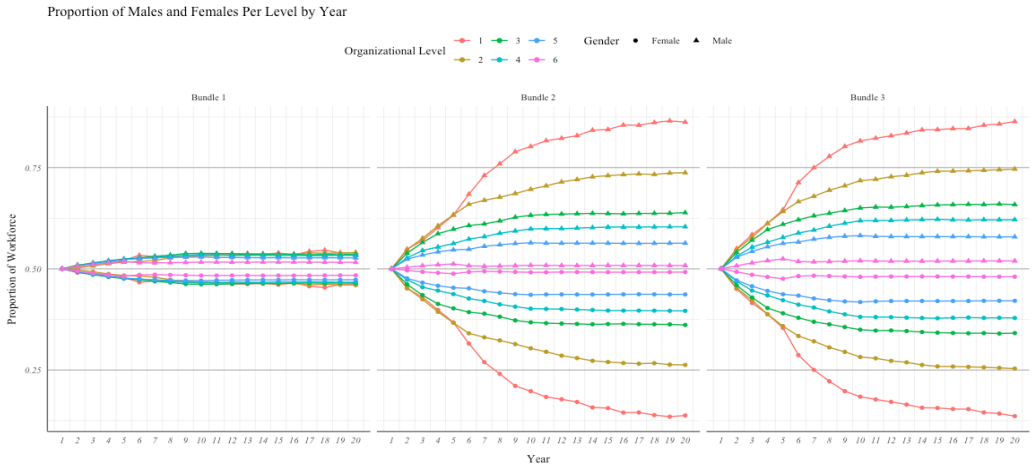

Figure 5. Gender Stratification Across Time and Organizational Level for Bundles 1, 2 and 3.

To evaluate changes in workforce potential across the HR bundles, the average perceived and true performance of males and females in each level of the organization was examined for each of the simulated conditions. Bundle 1 results show minimal differences in perceived performance of males and females at all levels. To demonstrate this result, the following values represent mean perceived performance for females and males in levels one (C-suite) through six (Entry Level) for year 15 in Bundle 1, respectively: $F = 128.87$, $M = 128.87$; $F = 128.00$, $M = 128.08$; $F = 124.67$, $M = 124.72$; $F = 118.40$, $M = 118.43$; $F = 109.89$, $M = 109.86$; $F = 99.47$, $M = 99.41$. Males and females are perceived to be performing at approximately the same rates when bias in performance appraisal evaluation and hiring practices is removed. Bundle 2 does not eliminate differences in perceived performance of males and females. To show this result, the following

values represent mean perceived performance for females and males in levels one through six for year 15 in Bundle 2, respectively: $F = 127.98$, $M = 130.59$; $F = 127.90$, $M = 129.59$; $F = 124.96$, $M = 125.93$; $F = 118.86$, $M = 119.54$; $F = 110.28$, $M = 110.99$; $F = 99.64$, $M = 100.76$. Males are still perceived to be outperforming females at all organizational levels. Bundle 3 also does not eliminate differences in perceived performance of males and females. To show this result, the following values represent mean perceived performance for males and females in levels one through six for year 15 in Bundle 3, respectively: $F = 127.92$, $M = 130.49$; $F = 127.76$, $M = 129.59$; $F = 124.84$, $M = 125.89$; $F = 118.67$, $M = 119.94$; $F = 110.14$, $M = 110.94$; $F = 99.55$, $M = 100.71$. In this case, males are also perceived to be outperforming females in all organizational levels (see Table 25a, 25b, and 25c for a summary of perceived performance in year 15 for males and females across organizational levels for Bundles 1, 2, and 3, respectively). Overall, Bundle 1 best reduced the discrepancy between male and female perceived performance over time (see Figure 6 for a visualization of differences in perceived male and female performance over time by organizational level).

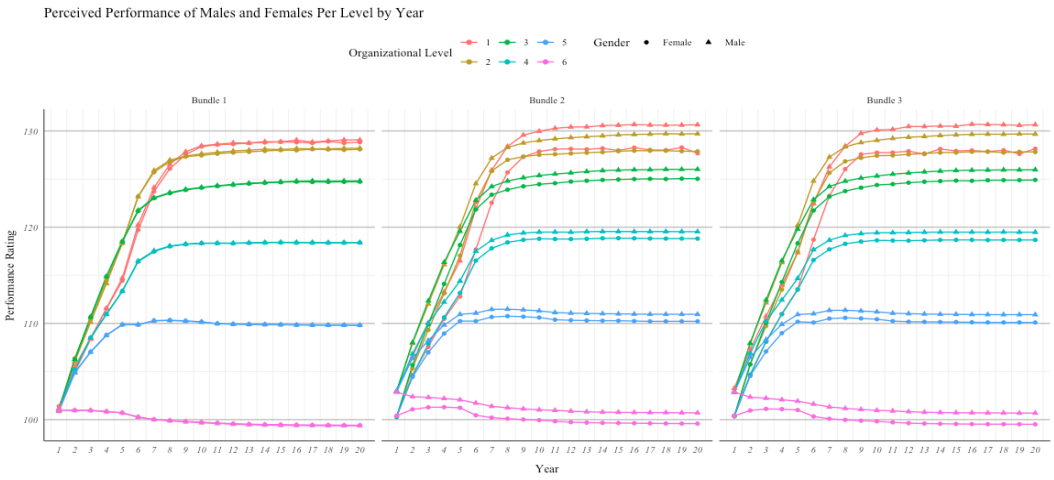

Figure 6. Perceived Performance Across Time and Organizational Level for Bundles 1, 2 and 3.

The average true performance of males and females in each level of the organization was also examined for each of the simulated conditions. Bundle 1 results again show minimal difference in true performance of males and females from levels one through six. To demonstrate this result, the following values represent mean true performance for females and males in levels one (C-suite) through six (Entry Level) for year 15 in Bundle 1, respectively: $F = 127.83$ $M = 127.86$; $F = 127.00$, $M = 127.11$; $F = 123.68$, $M = 123.72$; $F = 117.40$, $M = 117.43$; $F = 108.89$, $M = 108.86$; $F = 98.47$, $M = 98.41$. Males and females truly performed at approximately the same rates when bias in performance appraisal evaluation and hiring practices is removed. Bundle 2 results show slight differences in true performance of males and females. The following values represent mean true performance for females and males in levels one through six for year 15 in Bundle 2, respectively: $F = 127.64$, $M = 127.76$; $F = 127.29$, $M = 126.78$; $F = 124.42$, $M = 123.11$; $F = 118.29$, $M = 116.74$; $F = 109.73$, $M = 108.18$; $F = 99.09$, $M = 97.95$. Similar to results from VE1, female true performance exceeds that of males, excluding at the C-suite level, even though males occupy more higher-level positions. Bundle 3 also shows slight differences in true performance of males and females. To show this result, the following values represent mean true performance for males and females in levels one through six for year 15 in Bundle 3, respectively: $F = 127.38$, $M = 127.73$; $F = 127.24$, $M = 126.78$; $F = 124.28$, $M = 123.08$; $F = 118.13$, $M = 116.69$; $F = 109.59$, $M = 108.13$; $F = 99.00$, $M = 97.90$. In this case, females are also

outperforming males in all organizational levels, excluding in the C-suite level (see *Table 23a, 23b,* and *23c* for a summary of true performance in year 15 for males and females across organizational levels for Bundles 1, 2, and 3, respectively). Overall, Bundle 1 best reduced the discrepancy between male and female true performance over time such that males and females occupying each organizational level have similar true ability levels, whereas under Bundles 2 and 3, women have higher ability levels at each organizational level, excluding the C-suite, compared to males (see *Figure 7* for a visualization of differences in true male and female performance over time by organizational level).

Table 25a
Average True and Perceived Performance of Males and Females Across Organizational Levels in Year 15 for Bundle 1.

Condition	Organizational Level	Gender	Average True Performance	Average Perceived Performance
Bundle 1	C-suite (Level 1)	Female	127.83	128.87
			[122.16, 129.70]	[122.14, 133.61]
Bundle 1	C-suite (Level 1)	Male	127.86	128.87
			[122.34, 129.66]	[122.92, 133.02]
Bundle 1	SVP (Level 2)	Female	127.00	128.00
			[125.37, 128.23]	[125.88, 130.01]
Bundle 1	SVP (Level 2)	Male	127.11	128.08
			[125.57, 128.16]	[126.36, 129.64]

Bundle 1	VP (Level 3)	Female	123.68	124.67
			[122.88, 124.39]	[123.77,. 125.58]
Bundle 1	VP (Level 3)	Male	123.72	124.72
			[122.98, 124.42]	[123.91, 125.50]
Bundle 1	Senior Manager (Level 4)	Female	117.40	118.40
			[116.95.117.87]	[117.99, 118.94]
Bundle 1	Senior Manager (Level 4)	Male	117.43	118.43
			[116.97, 117.88]	[117.94, 118.93]
Bundle 1	Manager (Level 5)	Female	108.89	109.89
			[108.60.109.16]	[109.59, 110.20]
Bundle 1	Manager (Level 5)	Male	108.86	109.86
			[108.59, 109.12]	[109.58, 110.14]
Bundle 1	Entry Level (Level 6)	Female	98.47	99.47
			[98.21, 98.72]	[99.19, 99.73]
Bundle 1	Entry Level (Level 6)	Male	98.41	99.41
			[98.16, 98.65]	[99.14, 99.67]

Note: values within cells represent the average performance of individuals (i.e., males or females) occupying levels 1 or 6 in year 15. Bracketed values represent confidence

intervals for the average performance of individuals across 1,000 organizational simulations.

Table 25b
Average True and Perceived Performance of Males and Females Across Organizational Levels in Year 15 for Bundle 2.

Condition	Organizational Level	Gender	Average True Performance	Average Perceived Performance
Bundle 2	C-suite (Level 1)	Female	127.64	127.98
			[119.36, 129.94]	[119.20, 134.43]
Bundle 2	C-suite (Level 1)	Male	127.76	130.59
			[124.52, 129.36]	[126.91, 133.95]
Bundle 2	SVP (Level 2)	Female	127.29	127.90
			[124.78, 128.82]	[124.64, 130.74]
Bundle 2	SVP (Level 2)	Male	126.78	129.59
			[125.50, 127.73]	[127.99, 131.09]
Bundle 2	VP (Level 3)	Female	124.42	124.96
			[123.66, 125.14]	[123.90, 126.03]
Bundle 2	VP (Level 3)	Male	123.11	125.93
			[122.49, 123.74]	[125.10, 126.72]
Bundle 2	Senior Manager (Level 4)	Female	118.29	118.86

			[117.81, 118.79]	[118.23, 119.45]
Bundle 2	Senior Manager (Level 4)	Male	116.74	119.54
			[116.34, 117.15]	[119.07, 125.05]
Bundle 2	Manager (Level 5)	Female	109.73	110.28
			[109.44, 110.03]	[109.93, 110.59]
Bundle 2	Manager (Level 5)	Male	108.18	110.99
			[107.92, 108.43]	[110.68, 111.27]
Bundle 2	Entry Level (Level 6)	Female	99.09	99.64
			[98.81, 99.35]	[99.33, 99.94]
Bundle 2	Entry Level (Level 6)	Male	97.95	100.76
			[97.70, 98.20]	[100.49, 101.03]

Note: values within cells represent the average performance of individuals (i.e., males or females) occupying levels 1 or 6 in year 15. Bracketed values represent confidence intervals for the average performance of individuals across 1,000 organizational simulations.

Table 25c

Average True and Perceived Performance of Males and Females Across Organizational Levels in Year 15 for Bundle 3.

Condition	Organizational Level	Gender	Average True Performance	Average Perceived Performance
Bundle 3	C-suite (Level 1)	Female	127.38	127.92
			[114.83, 129.93]	[115.28, 134.88]

Bundle 3	C-suite (Level 1)	Male	127.73	130.49
			[124.34, 129.32]	[126.19, 133.68]
Bundle 3	SVP (Level 2)	Female	127.24	127.76
			[124.52, 128.84]	[124.43, 130.68]
Bundle 3	SVP (Level 2)	Male	126.78	129.59
			[125.50, 127.75]	[128.09, 131.05]
Bundle 3	VP (Level 3)	Female	124.28	124.84
			[123.44, 125.10]	[123.71, 126.01]
Bundle 3	VP (Level 3)	Male	123.08	125.89
			[122.39, 123.76]	[125.15, 126.72]
Bundle 3	Senior Manager (Level 4)	Female	118.13	118.67
			[117.61, 118.62]	[118.04, 119.27]
Bundle 3	Senior Manager (Level 4)	Male	116.69	119.49
			[116.30, 117.10]	[119.02, 119.98]
Bundle 3	Manager (Level 5)	Female	109.59	110.14
			[109.30, 109.87]	[109.80, 110.46]
Bundle 3	Manager (Level 5)	Male	108.13	110.94

			[107.85, 108.39]	[110.64, 111.22]
Bundle 3	Entry Level (Level 6)	Female	99.00	99.55
			[98.75, 99.26]	[99.27, 99.83]
Bundle 3	Entry Level (Level 6)	Male	97.90	100.71
			[97.64, 98.16]	[100.45, 100.99]

Note: values within cells represent the average performance of individuals (i.e., males or females) occupying levels 1 or 6 in year 15. Bracketed values represent confidence intervals for the average performance of individuals across 1,000 organizational simulations.

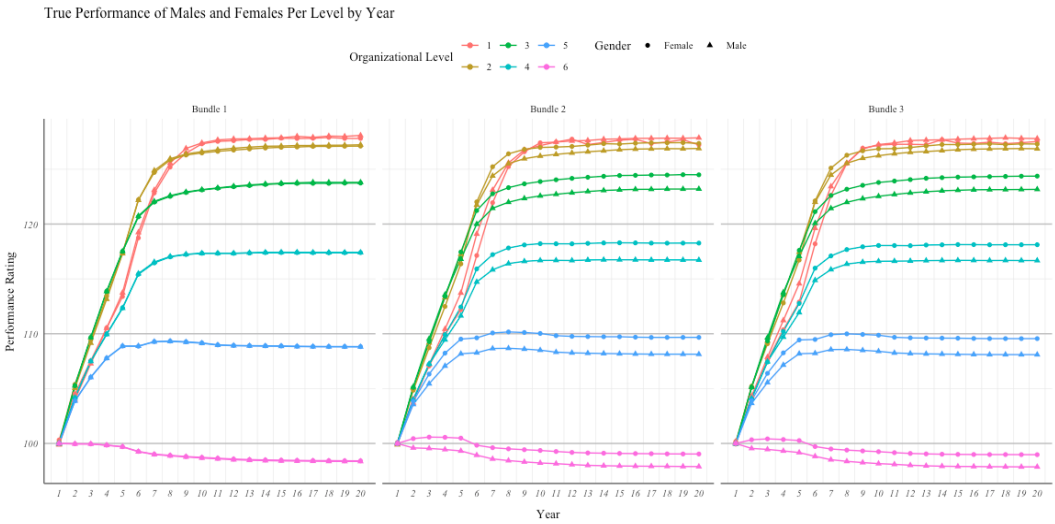

Figure 7. True Performance Across Time and Organizational Level for Bundles 1, 2 and 3.

Across all three conditions, differences between true and perceived performance are best minimized under Bundle 1 (reducing bias in performance evaluation and selection), followed by Bundle 3 (placing equal proportions of males and females in line positions), and Bundle 2 (providing equal

developmental opportunities and improving parental leave policies). Under Bundle 1, mean differences for true and perceived performance across gender by level (one through six) are as follows: $M = 1.02$, $M = 0.99$, $M = 1.00$, $M = 1.00$, $M = 1.00$, $M = 1.00$, and $M = 1.00$. Under Bundle 3 mean differences for true and perceived performance across gender by level (one through six) are as follows: $M = 1.90$, $M = 1.67$, $M = 1.68$, $M = 1.67$, $M = 1.68$, and $M = 1.68$. Under Bundle 2, mean differences for true and perceived performance across gender by level (one through six) are as follows: $M = 1.95$, 1.70, 1.68, 1.68, 1.68, and 1.68 (see Table 26 for values). The difference between true and perceived performance remains strongest in level one (C-suite) of an organization across all three conditions. When averaging across gender and organizational levels, the overall differences in performance between true and perceived organizational performance was $M = 1.00$, $M = 1.69$, and $M = 1.67$ under Bundle 1, Bundle 3, and Bundle 2, respectively (shown in Table 27). Overall, these results show that organizational workforce potential is maximized under Bundle 1, followed by Bundle 3, and Bundle 2. In other words, when bias in performance evaluation and selections is removed, the true performance of individuals more closely resembles the perceived performance of the same individuals, which enhances organizational workforce potential. However, improving developmental opportunities, parental leave policies, and female representation in line positions does not maximize organizational workforce potential as much as removing biases in performance evaluation and selection.

Table 26
True and Perceived Performance Across Levels by Condition for Year 15.

Condition	Organizational Level	True Performance Mean	Perceived Performance Mean	Difference
Bundle 1	C-suite (Level 1)	127.85	128.87	1.02
	SVP (Level 2)	127.05	128.04	0.99
	VP (Level 3)	123.70	124.70	1.00
	Senior Manager (Level 4)	117.42	118.42	1.00
	Manager (Level 5)	108.87	109.87	1.00
	Entry Level (Level 6)	98.44	99.44	1.00
Bundle 2	C-suite (Level 1)	127.62	129.57	1.95
	SVP (Level 2)	126.98	128.68	1.70
	VP (Level 3)	123.71	125.39	1.68
	Senior Manager (Level 4)	117.43	119.11	1.68
	Manager (Level 5)	108.87	110.55	1.68
	Entry Level (Level 6)	98.46	100.14	1.68
Bundle 3	C-suite (Level 1)	127.60	129.49	1.90
	SVP (Level 2)	127.01	128.68	1.67

VP (Level 3)	123.68	125.36	1.68
Senior Manager (Level 4)	117.41	119.08	1.67
Manager (Level 5)	108.86	110.54	1.68
Entry Level (Level 6)	98.45	100.13	1.68

Table 27
Average true, and perceived organizational performance for Bundles 1, 2, and 3 in year 15.

Condition	Overall True Organizational Performance	Overall Perceived Organizational Performance	Overall Difference Between True and Perceived Organizational Performance
Bundle 1	117.22	118.22	1.00
Bundle 2	117.17	118.86	1.69
Bundle 3	117.16	118.83	1.67

There are two explanations for why Bundle 1 reduced OGS and the discrepancy between true and perceived performance of males and females, while Bundles 2 and 3 did not. The first explanation is that bias in performance evaluation and selection are the strongest contributors to OGS compared to the remaining three factors (i.e., career decisions, familial effects, and differences in developmental opportunities). The present model calculated true and perceived performance evaluations of agents. True performance of agents was equal to an agent's true ability sampled upon entrance to the organization. Perceived

performance was calculated based on two factors: 1) sampled normal job duty performance, and 2) sampled developmental opportunity performance. Biases in developmental opportunities occur when sampling developmental opportunity performance by giving lower values to the performance opportunities of females, thus decreasing the number of "opportunities to perform" their developmental opportunities. Developmental opportunity performance is then sampled based on the number of opportunities agents receive. If agents receive fewer developmental opportunities, then they have more variation around their mean performance which impacts their overall developmental opportunity performance. Performance on normal job duties includes added bias points to the mean of the sampling distribution used, which more strongly impacts the samples by increasing the mean. Taken together, adding bias points to the sampling mean more strongly influences how perceived performance was calculated in the present model relative to other mechanisms.

The second explanation is developmental opportunities in the current model contribute to perceived performance via sampling from an agent's task ability the number of times that an agent decides to take developmental opportunities. This means that the more developmental opportunities an agent receives, the less variability there will be around his or her average developmental opportunity performance. However, this does not contribute to overall performance evaluation as directly as biases in performance evaluation do because this does not add to an agent's mean true ability. Additionally, reducing the number of females turning over as a result of taking parental leave does not

directly impact performance evaluations, thus making it a weaker contributor to overall organizational workforce potential. The mechanism for parental leave involves sampling a set proportion of individuals which impacts the performance evaluations of the individuals (i.e., reduces evaluations for females, increases evaluations for males). These individuals are then sampled to turnover as a result of taking leave. However, only a small number of individuals are impacted by this mechanism, which explains why the mechanism did not strongly impact results. Finally, placing an equal number of males and females in line positions did not reduce OGS. The present model favors those in line positions, and especially favors when males are in line positions. The mechanism for placing more females in line positions was static such that an equal number of males and females were in line positions initially within an organization. However, over time, the bias against females accumulated to overpower the effects of placing more females in line positions.

Discussion

The purpose of this study was to examine how five factors related to OGS interactively impact the proportion of men and women across organizational levels, and how organizational gender diversity, in turn, impacts organizational workforce potential. Research shows that women face barriers to career advancement at all levels within organizations (Baxter & Wright, 2000; Elliott & Smith, 2004; Eagly, 2007). This examination considered the emergence and interaction of both top-down (i.e., selection, performance appraisal, and developmental opportunities) and bottom-up processes (career and familial

effects) impacting OGS and organizational workforce potential. Organizations can take steps to reduce OGS by targeting the factors that produce OGS. This study utilized computational modeling to (1) examine the emergence of OGS as a function of interacting individual and organizational processes and (2) how human resources initiatives might mitigate OGS while improving workforce potential.

Results from the first virtual experiment show that under no bias in selection, performance appraisal, developmental opportunities, career choices, and familial effects, OGS does not emerge, and discrepancies between true performance and perceived performance of men and women are minimal. Although intuitive, these results serve as a baseline for studying OGS. However, even when there are small biases against women, there are large discrepancies in the proportion of men and women throughout an organization, and this is especially pronounced with each higher organizational level. On average, when there is low bias against women, men are perceived to perform better in their jobs. Yet, results show that if organizations capture true performance, they would find women outperform men across organizational levels, excluding in the C-suite. It is important to note that the primary route to top leadership positions is based on performance perceptions in the current study, and the discrepancies in true versus perceived performance of men and women has direct implications for promotability. In other words, women are typically evaluated differently than men (Foschi 1992; 1996, 2000; Mengel et al., 2017), which, in turn, impacts the proportion of women in each organizational level over time such that men are

perceived to be performing better than women, and thus, men are primarily being promoted into higher organizational levels. The organization is not promoting its top talent which impacts the workforce potential of an organization (i.e., human capital resources; Ployhart & Moliterno, 2011). A similar pattern of results emerged when large biases against women were present such that men were perceived to be performing better than women when, in reality, women were more capable than men in each level, excluding the C-suite. The primary difference between the effects of low bias and high bias in creating OGS is that under high bias, OGS occurs more rapidly than under low bias due to stronger deviations in perceived and true performance of men and women. Overall, OGS and the discrepancy between true and perceived performance are best minimized when bias is not present, thus resulting in higher organizational workforce potential.

Results from the second virtual experiment show how various HR initiatives differentially impact OGS and organizational workforce potential. Removing bias in performance evaluation and selection practices minimizes OGS, almost reducing it entirely. These results are due to equal performance perceptions of men and women. When women are viewed as performing as well as men, they are viewed as equally eligible for promotion, and thus, reducing OGS. Additionally, the discrepancy between true and perceived organizational performance are best minimized when removing bias in performance evaluation and selection, thus allowing organizations to promote their top talent, irrespective of gender. These results are not surprising considering the direct link between perceived performance and promotions within the model used in this study. In

other words, if individuals are promoted based on their perceived performance, and women face biases when their performance is evaluated, then biases women face translate into a disadvantage with respect to perceived promotability. When removing biases in developmental opportunities between men and women, and improving parental leave policies, OGS was surprisingly not mitigated. Results showed that OGS still occurs due to differences in how men and women are perceived to be performing. The same result is shown with equalizing the number of men and women in line and staff positions such that the career choices made by individuals does not reduce OGS. One explanation for these results is that the direct link between biases in evaluating performance and making promotion decisions is stronger than the more subtle mechanisms stemming from the other factors (i.e., developmental opportunities, paternity leave, line position experience). In other words, even if organizations are able to even the playing field in terms of providing women with managerial experience in line positions, provide equal developmental opportunities to men and women, and create parental leave policies that welcome women back into the organization, failing to remove bias in evaluation as a barrier will continue to reinforce OGS, thus impacting organizational workforce potential.

Overall, this study demonstrates the importance of examining interactive factors contributing to OGS. When there is low or high bias present in performance evaluations, selection, developmental opportunities, familial effects, and career decisions, OGS emerges relatively quickly. Additionally, for organizations seeking to reduce OGS and improve organizational workforce

potential, the present study finds bias in performance evaluation and selection to be the strongest contributors (of the five factors examined) to OGS and decreased organizational workforce potential. Thus, without reducing bias in performance evaluation and selection, focusing HR initiatives on the other three factors (i.e., developmental opportunities, familial effects, and career decisions) will not yield much value.

Implications for Theory and Practice

The present study has implications for both theory and practice. The computational nature of this study provides a theoretical exploration of factors relating to OGS and provides practical insights for organizations seeking to reduce OGS and improve organizational workforce potential. Below I provide three key theoretical implications, and three practical implications of the present study.

Theoretical Implications. There are three key theoretical implications of the present study. First, studying OGS requires an understanding of factors that impact OGS. Results of the present study reveal that OGS emerges relatively quickly when there is low and high bias, and that OGS occurs more severely with each increase in organizational level. This sheds light on the bottom-up nature of OGS such that it is an accumulation of effects from biases over time (Martell et al., 2012), confirming that OGS is a dynamic process that warrants longitudinal examination as year to year, small differences in promotions eventually manifest into substantial OGS over time.

Second, the present study built on past examinations of OGS by additionally considering the relationship between OGS and organizational workforce potential. Previous computational models of OGS have not considered the implications of examining true versus perceived performance evaluations, or linked OGS to organizational outcomes (Martell et al., 2012; Samuelson et al., 2018). Bias against women in the present study results in discrepancies between true and perceived performance, which holds implications for who is promoted within organizations. If organizations do not have a clear picture of who is best suited for advancement, then an organization suffers in their organizational workforce potential. The link between OGS and organizational workforce potential is crucial to study as it represents how OGS translates to organizationally meaningful outcomes. As such, the present study provides a theoretical examination of the organizational implications of OGS.

Third, this study demonstrates how various HR interventions impact OGS and workforce potential. Results from the present study suggest reducing biases in performance evaluation and selection best reduce OGS and improve workforce potential. Previous research finds a standardized interview process (Williamson et al., 1997) and multiple interview scales with detailed anchor ratings (Campison et al., 1997) enhances reliability of the selection process. Research also finds frame of reference training (Hauenstein, 1998), structured free recall, source monitoring, and error management training (Anderson et al., 2015) reduces biases in performance evaluations. The present study suggests better understanding the

application and effectiveness of these HR interventions is warranted to reduce OGS and improve workforce potential.

Practical Implications. This study also has multiple practical implications. First, this study provides practitioners with novel information regarding the impact of OGS in organizations on organizational workforce potential. Key organizational stakeholders are typically concerned with the bottom-line in their organizations, and this concern does not change with heightened awareness of biases against women within organizations (Women in the Workplace, 2017). Previous research finds a return-on-investment for increasing gender diversity in organizations such that gender-diverse organizations are more likely to bring in top talent, appeal to customers (Hunt et al., 2015) and have increased financial returns (Hoobler et al., 2016). The present study shows how these results emerge, which is due to a decreased discrepancy between how performance of men and women is perceived, thus allowing organizations to select and promote top talent.

Second, this study serves as an intervention tool for practitioners wishing to improve their organizational workforce potential by reducing OGS. Ideally, organizations would enact HR initiatives that combat all fives factors impacting OGS, which the present study demonstrates is most effective in mitigating OGS and improving organizational workforce potential. However, in reality, organizations have to decide which resources to allocate to HR initiatives. The present study recommends focusing efforts on examining and reducing biases in performance evaluation and selection practices will yield the most impact on OGS

and organizational workforce potential. To do this, organization can train employees to reduce bias in performance evaluations by conducting frame of reference training, structured free recall, source monitoring, and error management training (Anderson et al., 2015; Hauenstein, 1998). Organizations can additionally conduct interviews in a standardized manner and use multiple interviewers (Campion et al., 1997; Williamson et al., 1997).

Lastly, this study shows the value of studying both individual and organizational processes within organizations. Computational modeling is an approach that can be applied to a number of organizational issues (e.g., team cognition; Grand et al., 2016; turnover; Scullen et al., 2005), and it offers a cost-effective method of evaluating the nature of interactive processes and the potential impact of organizational interventions. Stakeholders that seek to understand how OGS unfolds and impacts workforce potential within their organizations can utilize the present model. The present model can be altered to match the organizational context under investigation to 1) provide an explanation for the current gender composition of an organization, and 2) serve as an intervention-evaluation tool to decide which set of interventions would yield the highest return-on-investment for reducing OGS and improving organizational workforce potential.

Limitations

This study has several limitations. First, computational modeling is a theoretical research tool that does not involve the collection of data; thus, it is not necessarily representative of reality. The external validity of a computational

model depends on how closely a model reflects empirical patterns. The present study used model parameters informed by the literature to mimic empirical patterns to minimize the effects of this limitation. Next steps would include gathering data on actual organizational processes. For instance, an empirical study can examine how an organization makes promotion decisions and evaluate the presence of biased decision-making.

Second, the present model represents only one particular way that the mechanisms underlying OGS operate. For example, for the C-suite level in all simulation runs, true performance of men exceeded that of women. This was due to the nature of 1) external hires and 2) how perceived performance was sampled. In a given simulation run, it was possible that 1) a woman was externally hired and had a sampled ability lower than that of the men present at that level, or that 2) in a given year, a woman's perceived performance was higher than her true performance due to variance in sampling which would result in promotion of a woman with lower true ability. This is only one way in which mechanisms for how agents are selected or promoted into organizational levels plays out. However, there could be alternative mechanisms relevant for explaining OGS. For example, external hiring criteria could be set to better select candidates into all levels based on more than just sampled ability, or variance in sampling for female performance can be reduced to model lower risk taking among females compared to males (Robison-Cox et al., 2007).

Third, to calculate organizational workforce potential, mean performance of men and women within each organizational level was aggregated to the

organizational level using the mean (i.e., using an additive model of compilation; Chan, 1998). This approach typically ignores the variance among the aggregated means. This approach was acceptable for the purpose of this study based on how organizational workforce potential was initially defined (i.e., as the sum of individual performance; Chan, 1998). However, it is possible that workforce potential is not a direct aggregate of individual performance, and that other methods, such as using maximal performance at a given level, is more representative of how a group of individuals is performing altogether to represent workforce potential.

Fourth, the present study only examined how five factors impact OGS (i.e., bias in performance evaluation, selection, developmental opportunities, familial effects, and career decisions). The five factors included in the model encompass other factors as well (i.e., "developmental opportunities" is designed to tap into opportunity seeking in terms of negotiations and self-improvement). However, other variables can impact promotability of individuals, such as risk taking (Robsion-Cox et al., 2007), number of hours worked (Bertrand, Goldin, & Katz, 2010), or the influence of workgroup composition (Murphy et al., 2007). Modeling risk taking among individuals can explore if increased risk taking by men results in increased upward mobility. For example, the standard deviation of average male performance can be increased to model this and can show if risk taking of men increases their likelihood of being promoted. Research shows reduced hours worked my women accounts partially for disparities in pay between male and female MBAs (Bertand et al., 2010). The present model does

not consider how much work an individual is doing, and this factor likely has implications for performance evaluations. Lastly, research shows belonging to a numerical minority in a group reduces the likelihood that a minority member will participate in the group (Murphy et al., 2007). The present study did not consider how work group participation impacts the other model factors (i.e., developmental opportunity seeking).

Fifth, the organizational context for this study was a moderately-large sized firm with cross-industry averages used as a guideline. Research shows differences in trajectories of men and women by sector (e.g., women are more represented in retail/restaurants and healthcare compared to industrial manufacturing and institutional investment; Women in the Workplace, 2017), and by race (e.g., white women comprise more C-suite positions than both men and women of color; Women in the Workplace, 2018). The present study did not consider a broader organizational context that could provide additional explanation for the emerged results. Consideration of organizational industry can inform additional parameters necessary for a more accurate depiction of reality. For example, the type of positions necessary for advancement expands beyond line and staff positions, especially when considering organizational industry. Additionally, considering race/ethnicity has implications for the manifestation of OGS, such as differential progressions into upper leadership for women of color compared to the progression of white women, men of color, and white men.

Future Research

The study's limitations provide numerous avenues for future research. Future research may additionally expand on the present model by 1) collecting data on purported mechanisms in the model, 2) assessing alternative mechanisms than those used in the model, 3) incorporating more model factors, and 4) expanding on organizational context. To evaluate the mechanisms of this computational model, empirical data can be collected to validate them. Grand et al. (2016) took a similar approach in studying team cognition by assessing their computational predictions using team samples. For the present study, data can be collected on an individual's true ability (e.g., intelligence testing) and on performance perceptions (e.g., performance evaluations), and can be compared to understand if men are being over-evaluated in their ability compared to women. This information would confirm or disconfirm the mechanism for comparing true and perceived organizational performance.

The present model is an examination of the theoretical space that the proposed factors operate in. Additionally, the current model presents one way in which various mechanisms operate (e.g., how workforce potential is calculated). However, as noted in the limitations, these calculations may not be entirely representative of real-world human processes, such as workforce potential aggregation. Future research can dig deeper into the aggregation of individual performance to organizational workforce potential by expanding beyond using an additive model of compilation (Chan, 1998), and consider how variations in performance within level impact overall organizational workforce potential. For example, perceived performance might be stronger at each level based on the

perceptions of how well a few individuals are performing rather than how an entire group of employees is performing.

Increasing the number of factors in the model is one way to more closely resemble reality. One use of computational modeling is to explain processes underlying individual behaviors (Harrison et al., 2007). Individual behaviors are not confined to a set of five factors, as demonstrated in this study. Future research can incorporate factors such as gender/ethnicity (Women in the Workplace, 2018), personality (Barrick & Mount, 1991), and/or motivational orientations (Payne et al., 2007), for example, to assess how additional individual characteristics differentially impact OGS manifestation. However, this does present an additional challenge in isolating the impact of individual effects in an interdependent model.

Lastly, expanding on organizational context to include organizational industry and other workgroup demographics is needed to round out the strongest factors impacting OGS. Future research can build on the current simulation by including organizational industry, such as healthcare versus finance, to assess the strongest factors relevant for the respective industries, and to see how the emergence of OGS changes based on the organizational context. Future research can also assess how workforce demographics, such as gender and racial composition of workgroups, impacts individual behaviors (i.e., examining the numerical minority phenomenon; Murphy et al., 2007).

Conclusion

This study aimed to understand how five factors (bias in performance appraisal, bias in selection, differences in developmental opportunities, career decisions, and familial effects) interactively impact OGS and ultimately impact organizational workforce potential. Overall, when no bias is present, OGS is diminished due to equalization of perceived performance and true performance of men and women. Under low bias, OGS emerges relatively quick (i.e., within 10 years) within each organizational level and becomes stronger with each increasing organizational level (i.e., OGS is substantially worse in the upper levels of an organization compared to lower levels). Under high bias, the same patterns emerge although they appear more rapidly and more severely. In examining potential HR initiatives, this study points to the criticality of examining bias in performance appraisal and selection practices. This HR bundle alone diminishes OGS by way of removing male-favoritism in evaluating performance of individuals, which allows organizations to promote their best talent regardless of gender. Focusing on only increasing the number of women in line positions, providing equal developmental opportunities for men and women, and improving parental leave policies are not enough to combat OGS based on the model created for this study. In sum, OGS is a complex process that accumulates over time as a result of subtle top-down and bottom-up processes. This study offers a computational model to illuminate and study the complexities involved in the emergence of OGS.

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Appendix A

Table A1
No Bias Workforce Potential by Level

Condition	Org Level	Gender	True Performance	Perceived Performance	Performance Difference
No Bias	1	Female	127.80	128.81	1.01
No Bias	1	Male	127.80	128.81	1.01
No Bias	2	Female	127.10	128.11	1.01
No Bias	2	Male	127.10	128.11	1.01
No Bias	3	Female	123.73	124.73	1.00
No Bias	3	Male	123.73	124.73	1.00
No Bias	4	Female	117.46	118.46	1.00
No Bias	4	Male	117.46	118.46	1.00
No Bias	5	Female	108.92	109.92	1.00
No Bias	5	Male	108.92	109.92	1.00
No Bias	6	Female	98.46	99.46	1.00
No Bias	6	Male	98.46	99.46	1.00

Table A2
Low Bias Workforce Potential by Level

Condition	Org Level	Gender	True Performance	Perceived Performance	Performance Difference
Low Bias	1	Female	127.62	129.25	1.63

Low Bias	1	Male	127.62	129.25	1.63
Low Bias	2	Female	127.00	128.66	1.66
Low Bias	2	Male	127.00	128.66	1.66
Low Bias	3	Female	123.70	125.37	1.67
Low Bias	3	Male	123.70	125.37	1.67
Low Bias	4	Female	117.42	119.09	1.67
Low Bias	4	Male	117.42	119.09	1.67
Low Bias	5	Female	108.87	110.54	1.68
Low Bias	5	Male	108.87	110.54	1.68
Low Bias	6	Female	98.46	100.14	1.68
Low Bias	6	Male	98.46	100.14	1.68

Table A3
High Bias Workforce Potential by Level

Condition	Org Level	Gender	True Performance	Perceived Performance	Performance Difference
High Bias	1	Female	127.29	129.17	1.89
High Bias	1	Male	127.29	129.17	1.89
High Bias	2	Female	127.10	128.76	1.66
High Bias	2	Male	127.10	128.76	1.66
High Bias	3	Female	123.91	125.59	1.69

High Bias	3	Male	123.91	125.59	1.69
High Bias	4	Female	117.54	119.24	1.70
High Bias	4	Male	117.54	119.24	1.70
High Bias	5	Female	108.89	110.60	1.70
High Bias	5	Male	108.89	110.60	1.70
High Bias	6	Female	98.43	100.14	1.71
High Bias	6	Male	98.43	100.14	1.71

Table A4
Bundle 1 Workforce Potential by Level

Condition	Org Level	Gender	True Performance	Perceived Performance	Performance Difference
Bundle 1	1	Female	127.85	128.87	1.02
Bundle 1	1	Male	127.85	128.87	1.02
Bundle 1	2	Female	127.05	128.04	0.99
Bundle 1	2	Male	127.05	128.04	0.99
Bundle 1	3	Female	123.70	124.70	1.00
Bundle 1	3	Male	123.70	124.70	1.00
Bundle 1	4	Female	117.42	118.42	1.00
Bundle 1	4	Male	117.42	118.42	1.00

Bundle 1	5	Female	108.87	109.87	1.00
Bundle 1	5	Male	108.87	109.87	1.00
Bundle 1	6	Female	98.44	99.44	1.00
Bundle 1	6	Male	98.44	99.44	1.00

Table A5
Bundle 2 Workforce Potential by Level

Condition	Org Level	Gender	True Performance	Perceived Performance	Performance Difference
Bundle 2	1	Female	127.57	129.26	1.69
Bundle 2	1	Male	127.57	129.26	1.69
Bundle 2	2	Female	126.98	128.68	1.70
Bundle 2	2	Male	126.98	128.68	1.70
Bundle 2	3	Female	123.71	125.39	1.68
Bundle 2	3	Male	123.71	125.39	1.68
Bundle 2	4	Female	117.43	119.11	1.68
Bundle 2	4	Male	117.43	119.11	1.68
Bundle 2	5	Female	108.87	110.55	1.68
Bundle 2	5	Male	108.87	110.55	1.68
Bundle 2	6	Female	98.46	100.14	1.68

Bundle 2	6	Male	98.46	100.14	1.68

Table A6
Bundle 3 Workforce Potential by Level

Condition	Org Level	Gender	True Performance	Perceived Performance	Performance Difference
Bundle 3	1	Female	127.56	129.20	1.65
Bundle 3	1	Male	127.56	129.20	1.65
Bundle 3	2	Female	127.01	128.68	1.67
Bundle 3	2	Male	127.01	128.68	1.67
Bundle 3	3	Female	123.68	125.36	1.68
Bundle 3	3	Male	123.68	125.36	1.68
Bundle 3	4	Female	117.41	119.08	1.67
Bundle 3	4	Male	117.41	119.08	1.67
Bundle 3	5	Female	108.86	110.54	1.68
Bundle 3	5	Male	108.86	110.54	1.68
Bundle 3	6	Female	98.45	100.13	1.68
Bundle 3	6	Male	98.45	100.13	1.68