The Gender Gap in Research Productivity is Narrowing but Parity Remains Elusive: An Allometric Analysis

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Abstract

We used allometric analysis to test whether the gender research productivity gap is narrowing and gender parity will be reached—and when. Study 1 included 2,600 researchers who published 1,595 articles in *Journal of Applied Psychology* (JAP) and Study 2 included 1,814 researchers who published 1,043 articles in *Academy of Management Journal* (AMJ) and 1,843 who published 930 articles in *Journal of Management* (JOM) from January 2002 to December 2017. Results were consistent across studies and revealed that productivity growth was greater for women than for men, providing evidence that the gap has narrowed over time. For example, if female annual output increased by twofold over a given time period, male annual output would increase by smaller rates of 1.43 (JAP), 1.36 (AMJ), and 1.40 (JOM). But, although the productivity gap is narrowing, results showed that achieving gender parity (i.e., the proportion of articles published by women matches the proportion of women in the researcher population) will not happen for at least several years (JOM) or decades (JAP and AMJ)—if ever—depending on the fields' future gender composition. Thus, results suggest that the historic female disadvantage or "output loss" associated with incremental differentiation, and the Matilda and Matthew effects are gradually diminishing because, as a group, women are outpacing men in publications. However, individually, women are predicted to continue to lag behind in average publishing rate. Thus, despite gains regarding representation, results point to the need for initiatives addressing real and perceived productivity barriers and constraints for women.

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Female scholars remain underrepresented in the academic doctoral workforce, especially among tenured faculty members and those in leadership positions (Eagly & Miller 2016; King, Bergstrom, Correll, Jacquet, & West, 2017; National Science Foundation, 2019). The vast majority of journal article authors are men in applied psychology and other fields (Aguinis, Ji, & Joo, 2018). These studies have been highly informative because they provide a snapshot of the current gender gap in research productivity. However, an important unanswered question is whether the gap is narrowing or widening. Also, a second unanswered question is whether and when gender research productivity parity will occur—if ever. To use a media analogy, answering these questions requires an examination of a "movie" rather than a "still shot." Also, answering these questions requires methodological approaches that are able to yield insights on growth rates over time, differences in growth rates between women and men, and whether growth rates predict eventual parity and whether parity is likely to happen—and when.

The goal of our study is to answer the aforementioned questions by examining the research productivity of men and women over time. Moreover, an important innovation of our study is that we implemented *allometric modeling*, which is a data-analytic technique that has been used successfully in biology and other fields for assessing the scaling properties of an output variable exhibiting proportionate or disproportionate growth in relation to another (Huxley, 1923; Kleiber, 1932). By introducing allometric analysis to address questions of importance for applied psychology theory and practice, we were able to compare the exponential growth in women's and men's yearly research outputs over time. Doing so allowed us to investigate whether the research productivity gap is narrowing or widening and, based on the growth rates for men and women, make predictions about at what point in the future we anticipate gender productivity parity to occur.

We conducted allometric modeling in two studies. In Study 1, we examined the entire population of 2,600 researchers who published at least one of the 1,595 articles in *Journal of Applied Psychology* (JAP) from January 2002 to December 2017.[1] In the interest of assessing the robustness and replicability of our results, in Study 2 we examined two management journals that are considered highly prestigious by members of the Society for Industrial and Organizational Psychology (Highhouse, Zickar, & Melick, in press): the 1,814 researchers who published at least one of the 1,043 articles in *Academy of Management Journal* (AMJ) and the 1,843 researchers who authored the 930 articles published in *Journal of Management* during the same 16-year period. In total, our analyses included 4,951 unique researchers and 3,568 articles over a 16-year period.

Results showed the exact same general pattern across the two studies: the rate of non-linear growth in research productivity was greater for women compared to men. Although men have produced and continue to produce a greater proportion of total outputs—a finding that has been documented extensively (e.g., Aguinis et al., 2018)—a novel insight based on our allometric analysis is that the growth rate of female productivity is now higher than that for men. Thus, we uncovered that the gender research productivity gap is, in absolute terms, narrowing. In addition, defining gender productivity parity as the point at which the proportion of articles published by women is similar to the proportion of women in the researcher population, parameters from the allometric equations revealed that parity will take at least several decades to occur—if ever.

[1] We initially considered also including *Personnel Psychology* but, as described later in the Limitations and Future Directions section, we were not able to do so given small sample size because this journal publishes approximately only 25 articles per year.

Our results based on using allometric analysis make several contributions to applied psychology theory and research. First, our findings generate new insights into how the gender productivity gap is changing. Results indicate that, as a group, women are outpacing men in publications; on average, however, women continue to lag behind men, and parity will not occur for at least several decades, if ever. Second, our allometric-based predictions regarding parity offer insights into the efficacy of organizational efforts to reduce gender gaps. As we describe in detail later in our manuscript, results suggest that the field has been more successful at producing and attracting female researchers than helping to boost women's productivity to match men's. Third, results revealed how the magnitude of the gender productivity gap differs across different disciplines and journals. For example, we found that applied psychology is similar to other fields such as mathematics and astronomy in that the gender productivity gap is narrowing (e.g., Roy et al., 2020). However, it also differs from other fields such as nanoscience and technology where women publish at nearly identical rates as men (Sotudeh & Khoshian, 2014). Finally, the paradoxical finding that the gap is narrowing but parity remains elusive helps to explain some of the contradictory findings recently reported in the literature. For example, numerous recent studies suggest that gender biases in scientific domains have "reversed" in women's favor (e.g., Breda & Hillion, 2016; Lutter & Schröder, 2016; Madison & Fahlman, 2020; Williams & Ceci, 2015), contradicting other studies suggesting that women remain substantially disadvantaged (e.g., Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012; Reuben, Sapienza, & Zingales, 2014; Sarsons, 2017). In terms of implications for practice, our findings point to the possibility that women are substantially less disadvantaged than before when it comes to degree attainment and faculty employment, but continue to face bias during various stages of scientific production process.

Theoretical Background

There are several theory-based explanations for the existing gender research productivity gap. These include incremental differentiation, the Matilda Effect, and the Matthew Effect. A consideration of these explanations leads to the prediction that the gap is not narrowing and parity is unlikely to be achieved in the near future. On the other hand, recent developments and empirical findings suggests that the opposite may be the case. First, given the importance of the gender research productivity gap for organizations and society in general—and the desire to narrow this gap—numerous governmental and educational organizations have implemented initiatives to increase women's representation and productivity in scientific domains (e.g., the National Science Foundation's ADVANCE program). Second, there is recent evidence that women are outpacing men in publishing rates across scientific domains. A consideration of these interventions and resource allocations as well as recent evidence of women's increasing productivity leads to the competing prediction that the gap is narrowing and parity is likely to be achieved in the near future. Next, we discuss each of these competing explanations and predictions in more detail.

Reasons why the Gap May not be Narrowing and Parity is Unlikely to be Achieved in the near Future

As mentioned above, there are three theoretical mechanisms that together lead to the prediction that the gender productivity gap is not narrowing and parity is unlikely to be achieved soon: incremental differentiation, the Matilda effect, and the Matthew effect. We address each in turn.

Incremental Differentiation

Aguinis et al. (2018) examined the individual cumulative productivity of researchers across multiple scientific domains who published at least one article in their respective fields' top journals between 2006 and 2015.[2] In all sampled domains, there was a disproportionate gender productivity gap in favor of men. Moreover, the gap was larger among top performers than among all performers, as women's underrepresentation became increasingly severe at more elite ranges of performance. In addition, the power law with exponential cutoff consistently had the best fit with the observed individual output distributions of both men and women. The power law with exponential cutoff distribution is created predominantly via the generative mechanism of *incremental differentiation*—the process in which individuals' total outputs increase at an approximately linear rate based on their accumulation rates (Joo, Aguinis, & Bradley, 2017). Thus, results indicated that variation in individuals' research outputs are driven predominantly by variation in their accumulation rates on key input components (e.g., education, social capital, research funding)—that is, researchers with greater accumulation rates enjoy greater linear output increments compared to others.[3]

Based on their findings, Aguinis et al. (2018) concluded that incremental differentiation is constrained for women, and proffered an explanation regarding the predominant cause. They theorized that, of the several competing mechanisms explaining the extant gender gap, namely (a) gender differences in ability, (b) gender discrimination, and (c) gender differences in career and lifestyle choices, gender discrimination is more pivotal than the others in producing a significant gender-based constraint on incremental differentiation (Aguinis et al., 2018). This is consistent with past research that has largely (though not exclusively) attributed situational constraints (e.g.,

[2] Samples consisted of researchers in applied psychology (N = 4,081), mathematical psychology (N = 3,796), genetics (N = 45,007), and mathematics (*N* = 3,853).
[3] As Aguinis et al. (2018) noted, the dominance of incremental differentiation does not preclude the presence of other mechanisms driving individual differences in research productivity. Their results were based on distribution pitting methodology, a falsification-based procedure that involves pitting theoretical distributions against one another with respect to fit with the observed distribution. Thus, other mechanisms may also explain individual differences in research productivity, albeit to a lesser degree compared to that of incremental differentiation.

limited resources) rather than person-based factors (e.g., ability) to explain differential levels of positive skew in exponential-tail distributions (Beck, Beatty, & Sackett, 2014; Joo et al., 2017).

Discrimination creates a gender-based constraint on incremental differentiation in two ways: First, women who face discrimination achieve smaller output increments than do men with comparable accumulation rates—in other words, discrimination hinders the capacity to convert inputs into stable outputs (Aguinis et al., 2018). Second, gender discrimination often affects the allocation and exchange of high-impact competitive resources (e.g., funding), meaning it can substantially hinder women's capacity to accumulate inputs, especially at rates as high as those attained by star performers. If such gender-based constraints on incremental differentiation persist, the gender productivity gap will likely not be bridged, and parity will likely not be achieved—that is, unless women "out-accumulate" men (i.e., accumulate at a greater rate compared to men) to offset the "female penalty."

The Matilda Effect

The *Matilda effect* refers to gender discrimination in which women's scientific achievements are undervalued relative to comparable achievements by their male counterparts (Rossiter, 1993). Literature on the history of science illustrates this phenomenon, documenting ample evidence of women's scientific contributions being overlooked or credited to men (Rossiter, 1993). Although overt discrimination in scientific fields is now rare (compared to several decades ago), the presence of covert—often unconscious—gender discrimination in "chilly climates" can inhibit women's domain interest, self-efficacy, and overall productivity and career success (Halpern et al., 2007; Tenenbaum & Leaper, 2003). For example, a recent study showed that women face disproportionate penalties for coauthored works, receiving less credit than their male coauthors (Sarsons, 2017). In addition, women receive a disproportionately smaller share of scientific awards and prizes (Lincoln, Pincus, Koster, & Leboy, 2012) and are viewed less favorably by others as potential collaborators (Diekman, Weisgram, & Belanger, 2015; Knobloch-Westerwick, Glynn, & Huge, 2013).

The Matilda effect can cause a gender productivity gap among researchers with similar abilities, motivation, and prior outputs (e.g., Carli, Alawa, Lee, Zhao, & Kim, 2016). In particular, it creates gender-based constraints at various stages of production in scientific research. For example, even if John and Sally enter the same institution with identical qualifications, Sally may receive disproportionately fewer resources (e.g., funding, collaboration interest) compared to John solely because of her gender—her input-accumulation is constrained in the early stages of production. But even if Sally acquires resources at the same rate as John, her capacity to convert accumulated inputs into stable outputs may be stifled (again because of her gender). When leading team projects, for example, Sally may face greater coauthor friction (e.g., during periods of creative dissent) in addition to other setbacks and process losses aggravated by gender stereotypes, which are often strongly linked to perceptions of leadership and power dynamics (Eagly & Karau, 2002). Finally, in the end-stages of production, output may be thwarted due to discrimination during peer reviews (e.g., Chesler, Barabino, Bhatia, & Richards-Kortum, 2010; Lortie et al., 2007), upon which receipt of a biased decision potentially nullifies the prospects of acquiring tenure, a grant, or other rewards that are important in shaping future productivity and career outcomes.

In applied psychology, there is a substantial gender productivity gap in spite of the field's relatively high female representation (Aguinis et al., 2018; Odic & Wojcik, 2020). Additionally, in an analysis of publication data across major psychology sub-disciplines during 2003-2017, gender gaps in publications and citations remained significant even after controlling for factors such as seniority, university affiliation, and number of coauthors (Odic & Wojcik, 2020).[4] In sum, if the Matilda effect persists, the gender productivity gap will likely not be bridged; likewise, parity will likely not be achieved unless women offset the Matilda effect by outperforming men.

The Matthew Effect

Over time, productivity differences between individual researchers tend to grow in magnitude. Merton (1968) coined the term *Matthew effect* to describe a process through which disparity in scientific achievements magnifies over time as prolific producers accumulate advantages over less prolific producers.[5] Formally, the Matthew effect is defined as the "accruing of large increments of peer recognition to scientists of great repute for particular contributions in contrast to the minimizing or withholding of such recognition for scientists who have not yet made their mark," (Merton, 1988, p. 609). Scholars who achieve eminence—through early breakthroughs, for example—attract peer recognition and valuable resources that make future success more probable (Allison, Long, & Krauze, 1982; Amo, Ada, & Sharman, 2012; DiPrete & Eirich, 2006; McGuire & Creamer, 1998; Petersen et al., 2014). The Matthew effect also involves a "self-fulfillment" component, as positive feedback and high-performance expectations from others motivate productive scholars to pursue continued prolificacy (Cole & Cole, 1967; Judge & Hurst, 2008). In short, the "rich get richer," as past successes lead to the accumulation of competitive advantages through various positive feedback mechanisms (Aguinis, O'Boyle, Gonzalez-Mulé, & Joo, 2016; Joo et al., 2017; Vancouver, Li, Weinhardt,

[4] As Odic and Wojcik (2020) notes, the finding suggests that sociological explanations are unlikely to fully account for the observed gender gaps; furthermore, biological explanations are unlikely to do so, given the absence of evidence that women are biologically less suited or less predisposed to psychology compared to men.
[5] The labeling of the "Matthew effect" is based on a New Testament passage from the gospel of Matthew: "For whosoever hath, to him shall be given, and he shall have more abundance: but whosoever hath not, from him shall be taken away even that he hath" (Matthew 13:12).

Steel, & Purl, 2016).

The Matthew effect is well documented in scientific domains and other spheres of life (DiPrete & Eirich, 2006; Willson, Shuey, & Elder, 2007). In early education, small individual differences in academic performance widen over time as precocious students accumulate competitive advantages (e.g., greater attention and resources from teachers and parents) that make subsequent successes more probable (Baumert, Nagy, & Lehmann, 2012). For early-career researchers, individual differences in the number of early publications and PhD institution can lead to larger subsequent gaps in publication rates, citations, and job prestige (Feldon, Maher, Roksa, & Peugh, 2016; Headworth & Freese, 2015; Horta & Santos, 2016). Likewise, among mid- to senior-career researchers, highly recognized individuals have a significant advantage in acquiring competitive resources such as grants, work flexibility, collaboration interest from capable colleagues, and citations (Amo et al., 2012; Allison et al., 1982; Azoulay, Stuart, & Wang, 2014; McGuire & Creamer, 1998).

According to the Matthew effect, an existing gender productivity gap should widen over time as male researchers accrue cumulative advantages over female researchers and findings from recent studies suggest that this seems to be the case. In a longitudinal examination of productivity data from six cohorts of mathematicians (i.e., starting from the 1970-1974 cohort and ending with the 2000-2005 cohort) showed that, for each cohort, the gender gap in per capita publishing rate grew steadily as the number of years after career start increased from 1 to 10 (Roy et al., 2020). The same general result was found in astronomy and theoretical physics (Roy et al., 2020). Similarly, in two studies examining an identical cohort of researchers (across psychology, economics, and education), men had significantly more publications, higher job positions, and higher job mobility compared to women approximately 13 years after their PhD (van den Besselaar & Sandström, 2016), despite the absence of significant gender differences in performance approximately 3 years after their PhD (van Arensbergen, van der Weijden, & van den Besselaar, 2012).

In summary, a consideration of incremental differentiation, the Matilda effect, and the Matthew effect lead to the prediction that the gender productivity gap is not narrowing and that parity will not be achieved anytime soon. More formally, we offer the following hypotheses:

Hypothesis 1a: The gender research productivity gap is not narrowing.

Hypothesis 2a: Gender productivity parity will not be achieved in the near future.

Reasons why the Gap May be Narrowing and Parity is Likely to be Achieved in the near Future

In contrast to Hypotheses 1a and 2a, there is a body of recent empirical findings suggesting that the gender productivity gap is narrowing and that parity will be achieved in the near future. These findings are explained by two set of factors: (1) demand-side factors, which include various efforts aimed at making scientific careers and organizations more attractive to women; and (2) supply-side factors, which include evidence that women are steadily outpacing men in degree attainment, faculty employment, and average publishing rates across scientific disciplines. We address each next.

Demand-side Factors: Organizational Efforts to Reduce Gender Gaps

Demand-side factors reflect the rise in societal demand for "gender-blind" science and increasing institutional pressures facing organizations to adopt diversity goals (Bonet, Cappelli, & Hamori, 2020; Leslie, Manchester, & Dahm, 2017). Regional and global efforts to boost women's scientific representation have proliferated in recent years, reflecting the rise in societal demand for female scientists. For example, in the United States, the National Science Foundation (NSF) facilitates the *ADVANCE* program as part of a multifaceted strategy to promote gender equity in the science, technology, engineering, and mathematics (STEM) workforce. The *ADVANCE* program awards funds to projects aiming to increase female scientific participation and advancement. Since 2001, NSF has invested over $270M to support *ADVANCE* projects at higher education institutions and non-profit organizations. Similarly, the Australian Academy of Science recently launched the *Women in STEM Decadal Plan*, which is a 10-year action plan intended to generate sustained increases in Australian women's participation in STEM fields by 2030. At the global level, the *Gender Gap in Science* project (Roy et al., 2020) was recently completed through the joint effort of 7 member unions of the International Science Council (ISC) and 4 other organizations, including the United Nations Educational, Scientific, and Cultural Organization (UNESCO). Together, these eleven international organizations analyzed millions of scientific publications, and developed a working database of best practices for reducing extant gender gaps in scientific representation and research productivity. These are but a few of the plethora of initiatives and resource allocations being undertaken by governmental, educational, and professional organizations across the globe.

Compared to natural and formal science fields (e.g., physics and mathematics), most social science fields have better female representation and thus attract a smaller share of organizational efforts to reduce gender gaps. While smaller in relative terms, however, efforts have surged nonetheless in applied psychology. For example, in the Society for Industrial and Organizational Psychology's (SIOP) annual conferences, the number of sessions under the primary content area of "Inclusion/Diversity" (a large portion of which is dedicated to gender issues) has steadily increased: there were 34, 49, and 53 sessions in years 2008, 2012, and 2016, respectively. In 2017, the *Women's Inclusion Network* SIOP committee was initiated to focus on issues related to women's treatment, inclusion, and experiences within SIOP and the I-O psychology field as a whole. Moreover, organizations such as the American Psychological Foundation award generous scholarships and grants to female students in psychology. A similar pattern of rising efforts can be observed in the management domain. In the Academy of Management's (AOM) annual conferences, the number of professional development workshops with the keyword "gender" almost doubled from 12 to 21 during 2015-2019. Business schools and professional organizations (such as the American Association of University Women) provide ample funding opportunities to female students in management. Also, management and psychology scholars alike regularly work at the forefront of gender balancing initiatives in prominent business schools, creating and disseminating knowledge to support women's advancement in business, education, and other areas of life.

In addition to outside efforts (e.g., government initiatives)—which typically address disparities at the national or global level—higher education institutions have been increasingly adopting diversity goals to improve their internal gender balance. Concurrent with the widespread adoption of diversity goals in contemporary organizations, research has emerged suggesting that gender biases have in some cases reversed (i.e., in women's favor). In the United States, a hiring experiment comparing identically qualified female and male hypothetical applicants revealed a 2 to 1 preference for women by STEM tenure-track faculty (Williams & Ceci, 2015). In Germany, female sociologists have 23-44% fewer publications than their male counterparts when receiving tenure (Lutter & Schröder, 2016). Likewise, in Sweden, women significantly lag behind men in publications and citations when being promoted to the professor rank (Madison & Fahlman, 2020). Also, in France, a natural experiment revealed a grading bias towards women in teaching accreditation exams used to recruit university professors (Breda &

Hillion, 2016). These and similar recent findings indicative of a "female premium" challenge the idea that women remain heavily disadvantaged in scientific careers due to discrimination (e.g., Moss-Racusin et al., 2012; Reuben et al., 2014; Sarsons, 2017). At the very least, there has been a sharp increase in studies concluding that discrimination against women has substantially declined, particularly in hiring and promotion—two pivotal drivers of women's representation and status in the domain. As society and organizations continue to advocate and pursue greater gender diversity in scientific domains—there are no signs of efforts stagnating—the prediction is that it may not take long for the extant gender productivity gap to close and for parity to be achieved.

Supply-side Factors: Women Outpace Men in Degree Attainment, Faculty Employment, and Publishing Rate

Supply-side factors suggest that, as more and more women opt in to academic careers, where the demand for female researchers is high, they may outpace and eventually overtake men in research productivity. In fact, women have outpaced men in doctoral degree attainment in almost all broad fields of science (National Science Foundation, 2019). Figure 1 depicts the steady rise in women's share of PhDs conferred annually in the fields of (1) behavioral and social sciences (which includes applied psychology) and (2) business and management from 1965 to 2015 (American Academy of Arts and Sciences, 2017). In behavioral and social sciences, the proportion of female PhD earners grew from 15.6% to 40.1% during 1970-1985 and from 55.6% to 59.9% during 2000-2015; similarly, in business and management, they grew from 1.6% to 16.8% during 1970-1985 and from 30.9% to 42.8% during 2000-2015 (American Academy of Arts and Sciences, 2017). Moreover, women have outpaced men in faculty employment at universities and 4-year colleges and women's share of the academic doctoral workforce grew from 32.6% to 37.8% during 2006-2017 (National Science Foundation, 2019). Specifically within US business schools, women's share of full-time faculty grew steadily from 25.1% to 34.5% during 2004-2017, which is a mean annual increase of 0.72% (AACSB, 2004-2017). Although the figures vary by discipline—for example, female faculty representation is higher in management compared to finance (AACSB, 2017)—the phenomenon of women outpacing men, both in degree attainment and faculty employment, seems to occur in applied psychology, management, and other scientific fields.

The growing supply of female scientists leads to the prediction that the gender productivity gap is narrowing. Simply put, as female scientists grow in number, so should their total research output, ceteris paribus. Thus, as women's share of the research workforce grows, they could outpace (and in time overtake) men in outputs. Recent studies have confirmed that the gender productivity gap seems to be narrowing in numerous scientific disciplines. For example, according to simple linear slopes of publication data from over 200,000 psychology articles, the first-author gender gap across 125 psychology journals has been shrinking since 2003 and was bridged as of 2011 (the last-author gender gap, however, has remained much more constant); in the applied-mathematical psychology sub-discipline specifically, the first-author gender gap is predicted to be bridged in 2020 (Odic & Wojcik, 2020). Similarly, an analysis of over 240,000 articles produced in Indian institutions showed that the gender productivity gap across 14 scientific fields (including social science) has narrowed over time: the female-to-male ratio in first authorships increased from 0.35 to 0.43 during 2008-2017 (Paswan & Singh, 2020). Moreover, an analysis of over 3 million mathematics articles (conducted as part of the *Gender Gap in Science* project by Roy et al., 2020) revealed that women's share of total authorships has been increasing steadily for the past five decades. Additional analyses replicated the finding that the gender productivity gap is narrowing in the fields of astronomy and astrophysics, and theoretical physics (Roy et al., 2020).

On the other hand, the growing supply of female scientists has no direct bearing on whether parity will be achieved soon. That is, even if women outpace men in the research workforce—and eventually bridge the productivity gap—parity will remain elusive insofar as women lag behind men in *per capita* productivity, or average publishing rate, which is still the case in the field of psychology. Across the major psychology sub-disciplines, women's average publishing rate over recent years is about 69% of men's: during the 15-year period from 2003 to 2017, women published 2.44 articles on average, whereas men published 3.56 (Odic & Wojcik, 2020).[6]

Nonetheless, a body of research indicates that female scientists are steadily catching up to their male counterparts in average publishing rate, hence suggesting that parity may be achieved in the near future. To illustrate, during 1968-1979, women's average scientific publishing rate was about 57% of men's—women produced 6.4 scientific articles on average, whereas men produced 11.2 (Cole & Zuckerman, 1984).[7] By the late 1980s to early 1990s, however, that figure rose to 75%-80% (Xie & Shauman, 1998). Likewise, in Australian universities, women's publishing rate of books and articles combined grew from 57% of the male average in 1991-1993 to 76% in 2005-2007 (Bentley, 2011). In astronomy specifically, women's average productivity after 10 years of an active career rose from 75% of men's for the 1970-1975 cohort to over 95% for the 2000-2005 cohort; the same general result was also found in mathematics and theoretical physics (Roy et al., 2020). Moreover, in nano science and technology, there was no significant

[6] Estimates are based on data from researchers who have published at least one article in selected psychology journals during 2003-2017 and thus do not account for those in the field who have not yet published.
[7] Estimates are based on publication in the fields of astronomy, biochemistry, chemistry, earth sciences, mathematics, and physics.

gender difference in average productivity during 2005-2007, in spite of the substantial gender gap in representation (Sotudeh & Khoshian, 2014). These and similar recent findings suggest that women may continue to outpace men in publishing rates until gender parity is achieved across scientific domains.

In summary, a consideration of demand-side and supply-side factor leads to the prediction that the gender productivity gap is narrowing and that parity will be achieved in the near future. More formally, we offer the following hypotheses competing directly with Hypotheses 1a and 2a, respectively:

Hypothesis 1b: The gender research productivity gap is narrowing.

Hypothesis 2b: Gender research productivity parity will be achieved in the near future.

Study 1: Method

Sample

Our sample consisted of all researchers who have published at least one article in JAP from January 2002 to December 2017. In total, there were 2,600 researchers who published 1,595 articles and of whom 1,068 (41.1%) were women.

Measures

Research Productivity: Number of Authorships per Year by Each Gender

We measured research productivity by counting the number of articles produced by each author and publication year, then summing that number across individuals within gender. We first used the Web of Science database to identify all articles and their authors. We filtered the search results to include “articles” and “reviews” only, excluding all other types of publications such as editorials and errata. We then referred to the metadata associated with each article to record the publication year and names of all authors, using the Open Researcher and Contributor

ID to identify unique authors as needed. Subsequently, for each journal, we recorded the year-by-year total count of articles produced, or (co)authorships across individuals within each gender.

Gender

Following the procedure employed by Aguinis et al. (2018), we recorded each author's gender based on his or her first name and other information—such as a photo—available online (e.g., on the author's faculty webpage or ResearchGate profile). If the gender associated with a first name was ambiguous and we could not find information online that would reveal the author's gender, we used the website Namepedia.org to find the gender most strongly associated with that name.

Data Analytic Approach

Tests of Hypotheses 1a versus 1b: Allometric Analysis

Allometric modeling is a technique first implemented in biology to assess the scaling properties of a variable exhibiting disproportionate growth in relation to another variable. For example, an *isometric* or linear scaling relationship is present in organisms whose individual body parts grow in proportion with their total body size (Huxley, 1923). In contrast, there is an *allometric* or power law scaling relationship between a vast majority of mammals' basal metabolic rates and their body mass, where the former scales to the latter to the power of ¾ (Kleiber, 1932).

In biology, researchers have used allometry in important discoveries as described in a 1997 *Science* article (West, Brown, & Enquist, 1997). For example, allometric scaling explains the growth of animals' body parts in relation to total growth (Huxley, 1923) as well as the relationship between mammals' basal metabolic rates and body mass, known as Kleiber's law

(Kleiber, 1932). Since the introduction of allometry, it has been used to detect allometric scaling in a variety of natural, technical, and social systems. For example, In bibliometric research, allometric equations have been used to represent Price's model regarding the growth of citation networks among journal articles (de Solla Price, 1965), Bradford's law on the distribution of literature on a given subject matter across different journals (Bradford, 1946; Brookes, 1969; Naranan, 1989), and Zipf's law on the distribution of word frequencies in texts.

To test Hypotheses 1a versus 1b, we examined the scaling relationship between women and men. Specifically, let Equations 1 and 2 describe the research productivity of women (P_f) and men (P_m), each growing exponentially in time (t):

$$P_f = P_f(0)\, e^{at} \tag{1}$$

$$P_m = P_m(0)\, e^{bt}, \tag{2}$$

where t represents time; $P_f(0)$ and $P_m(0)$ represent P_f and P_m, respectively, when $t = 0$; and a and b represent the growth constants associated with P_f and P_m. In our study, the parameters a and b represent the rate of non-linear growth in research productivity for women and men, respectively. As such, the finding of a larger parameter value associated with one gender group (over the other) would indicate a comparatively greater non-linear growth rate for that group.

By solving for time (t) in Equations 1 and 2 (i.e., creating one expression for t as a function of P_f and another as a function of P_m, and then setting them equal to each other), we create a new equation where the variable time (t) has been eliminated. This results in the power-law or allometric equation depicted in Equation 3. In other words, combining Equations 1 and 2 results in the following allometric equation describing the scaling relationship between P_f and P_m (Katz, 2005; Ronda-Pupo, 2017; Sahal, 1981):

$$P_m = C{P_f}^{\alpha}, \tag{3}$$

In Equation 3, the scaling exponent alpha (α) is equal to the ratio of exponential parameters *b* to *a* in Equations 1 and 2 (i.e., α is equal to *b* over *a*). Accordingly, the magnitude of alpha reflects whether research productivity grows disproportionately faster for one gender group compared to the other. Specifically, an alpha value that is greater than 1 would indicate an allometric scaling relationship where productivity grows faster for men than women; thus, it would serve as evidence in support of Hypothesis 1a (i.e., that the gap is not narrowing). In contrast, an alpha value that is less than 1 would indicate that productivity is growing faster for women and thus serve as evidence in support of Hypothesis 1b (i.e., that the gap is narrowing). An alpha value that is precisely equal to 1 would indicate the presence of an isometric or linear scaling relationship in which research productivity grows proportionately across genders. Additionally, the constant *C* in Equation 3 is a function of female and male research productivity at $t = 0$, i.e., $P_f(0)$ and $P_m(0)$, and their growth constants, *a* and *b*, as shown in Equation 4:

$$C = \frac{P_f(0)^a}{P_m(0)^b} \tag{4}$$

Next, we solved for the exponent α by performing a log-log transformation of Equation 3. To wit, an allometric relationship between two variables (i.e., $Y = kX^{\alpha}$) is tantamount to a linear relationship between the logarithms of those same variables; namely, $\log(Y) = \log(k) + \alpha \log(X)$. Thus, by performing a linear regression on the logarithms of those variables, we can estimate the size of exponent α, which becomes the slope of the regression line. Hence, we estimated the size of exponent α by fitting a linear regression line to the logarithmic transformation of the allometric equation (i.e., Equation 3), as shown in Equation 5:

$$\log(P_m) = \log(k) + \alpha \log(P_f) \tag{5}$$

To assess the predictive effectiveness of the regression models, we computed the predicted R^2, which reflects how well a regression model predicts responses for new observations.

Test of Hypotheses 2a versus 2b: Scenario-based Predictive Analyses

To test Hypotheses 2a versus 2b, we estimated the year in which parity would occur. Because parity is that the proportion of articles produced by women matches the proportion of women in the field, predicting when this would occur required us to determine: (a) how research productivity will grow for each gender, and (b) how the gender composition of the field will evolve in the future. To do so, we performed the following procedure: First, to estimate the productivity trajectory for each gender, we fit exponential trendlines to the observed data points (i.e., annual research productivity counts for each gender). In other words, we made predictions about each gender's productivity (i.e., their future annual count of JAP authorships) based on the observed exponential growths during 2002-2017.[8]

Second, we chose 44% as being the 2011 estimated proportion of women in the applied psychology field, and then made predictions about how gender composition in the field would evolve henceforth. We chose the baseline estimate of 44% because that was the reported share of women among university-employed SIOP members in 2011 (Gardner, Ryan, & Snoeyink, 2018), and we determined that this was our best available proxy for the proportion of women in the field. In short, 44% was the "parity target" for 2011—accordingly, if women had produced 44% of applied psychology articles in 2011, we would determine that parity had been achieved in that year. The next step in our analysis involved predicting how the parity target of 44% would

[8] For each gender, we compared the coefficient of determination R^2 of the overlaid exponential trendline to that of linear, logarithmic, and power law trendlines. We also repeated these comparisons after binning the data into 2-, 3- and 4-year intervals. In almost all comparisons, exponential trendlines had a greater R^2 (and thus explained more of the variance in annual productivity) compared to linear, logarithmic, and power law trendlines. Detailed results are available from the authors upon request.

evolve past year 2011. To this end, we made the following assumption: the share of women in applied psychology grows proportionately to that of full-time faculty in business schools. In other words, we assumed that if the proportion of women among business school faculty increases by 1%, the proportion of women in applied psychology will likewise increase by 1%. This is a somewhat strong assumption, given that gender composition changes across the business sub-disciplines (such as accounting and finance) do not precisely mirror that in applied psychology. Nonetheless, we determined that future gender composition changes across the two domains (i.e., applied psychology and business) would bear a high degree of resemblance, given that past data reveals highly similar growth rates in the percentage of female doctoral recipients across the two domains from 1966 to 2015 (as shown in Figure 1). We obtained past data regarding the gender composition of full-time business school faculty from the AACSB's Business School Questionnaires for years 2004-2017 (AACSB, 2004-2017).

Third, we calculated multiple parity targets for each year following 2017, based on the following three scenarios: the proportion of women in the field (a) grows at a constant rate, (b) grows at a decreasing rate, or (c) grows at an increasing rate. We decided to examine these three scenarios to account for the uncertainty regarding future gender composition changes. To illustrate, hypothetically, the supply- and demand-side factors and conditions that drive gender composition in the field (e.g., postgraduate attrition and faculty employment rates across genders) may remain more or less constant, resulting in future female growth that is approximately linear. On the other hand, these factors and conditions may evolve in such a way that the proportion of women in the field grows at a decreasing rate—for example, organizational efforts to attract more women may stagnate as gender diversity rises in the field and organizations face resource constraints due to COVID-19—resulting in female growth that is approximately logarithmic. Alternatively, the proportion of women in the field may grow at an increasing rate—for example, the field may become increasingly attractive to prospective female researchers as universities recruit and hire more female faculty—resulting in future female growth that is approximately exponential. As such, we considered three scenarios in which future female growth is linear, logarithmic, or exponential. To compute parity targets in the first scenario (i.e., assuming constant female growth), we first estimated the future proportion of women across the business disciplines, which we did via fitting a linear trendline to the AACSB's data points. Next, we used those estimates to predict the future proportion of women in applied psychology, using the previously described assumption that female growth occurs proportionately across the two domains, applied psychology and business. We repeated the foregoing procedure in the second and third scenarios, but instead of overlaying a linear trendline to the AACSB's data points, we overlaid logarithmic and exponential trendlines, respectively.

Finally, to estimate the year in which parity would occur, we computed the point at which the female future share of JAP authorships would intersect with the parity target in each scenario.

Study 1: Results

Descriptive Results

Figure 2 depicts the research productivity of women and men over time in JAP. During the 16-year period from January 2002 to December 2017, women produced 35.0% of all authorships. Thus, women's share of total output was smaller than the 2011 parity target of 44% (i.e., the proportion of women among university-employed SIOP members in 2011; Gardner et al., 2018). Table 1 summarizes the year-by-year research productivity counts (and shares) by each gender.

Test of Hypotheses 1a versus 1b: Is the Gap Narrowing?

Table 2 summarizes results of the allometric regression based on Equation 5. The R^2 value of the allometric model was .69, which means that (the logarithm of) women's research productivity explains 69% of the total observed variation in (the logarithm of) men's research productivity. The predicted R^2 value of the model was .62. The scaling exponent alpha (α) was smaller than 1, indicating the presence of an allometric scaling relationship in favor of women (i.e., the non-linear growth rate in research productivity is greater for women than for men). Specifically, $\alpha = .52$ means that male productivity scales to female productivity to the power of .52. In practical terms, this suggests that if women's authorships in JAP increase by twofold from one year to another, men's would increase by 1.43 fold during the same time period. Results thus support Hypothesis 1a over Hypothesis 1b: the gender productivity gap is narrowing.

Test of Hypotheses 2a versus 2b: Is Gender Parity Likely to Occur in the Near Future?

Table 3 summarizes our predictions regarding women's annual share of total JAP outputs from 2020 to 2050. We generated these estimates by fitting exponential trendlines to the observed productivity data points during 2002-2017 and then extending those lines into the future. For example, our findings suggest that, in year 2050, women will produce 45.7% of total outputs in JAP.

Table 4 summarizes how the parity target will change beyond the 2011 baseline estimate of 44%. As described previously, we estimated separate parity targets according to the following three scenarios: the proportion of women in the field (a) grows at a constant rate, (b) grows at a decreasing rate, or (c) grows at an increasing rate. As shown in Figure 3, we overlaid linear, logarithmic, and exponential trendlines to the AACSB's data points regarding women's share of full-time business school faculty, with each trendline representing gender composition change in each of the scenarios. For example, in the scenario where the proportion of women in the field grows at a stable rate, we predict that women will comprise 55.1% of all business school faculty and 69.3% of all applied psychology researchers by 2050, making 69.3% the parity target for 2050. On other hand, in the scenario where the proportion of women in the field grows at a decreasing rate, 50.0% was the parity target for 2050. Alternatively, in the scenario where the proportion of women in the field grows at an increasing rate, 84.5% was the parity target for 2050.

Lastly, Table 5 summarizes our estimates regarding when parity will occur. First, we estimated the years in which women's share of total outputs will reach the 2011 parity target of 44% as well as a set of discrete percentages, ranging from 50% to 90% and in 10% increments. For example, the prediction is that women will achieve the 2011 parity target of 44% in year 2045. Also, women are predicted to produce 50% of annual output in JAP in year 2066. Next, we estimated the years in which women's share of total outputs will match the parity target for each of the three scenarios. First, in the scenario where the proportion of women in the field grows at a constant rate, parity will virtually never be reached, as the parity target will continue to exceed women's share of total outputs until the former (unrealistically) reaches 100%. Second, in the scenario where the proportion of women grows at a decreasing rate, parity is predicted to be achieved in year 2071. Third, in the scenario where the proportion of women in the field grows at an increasing rate, parity will virtually never be reached. In summary, parity is not predicted to occur earlier than year 2071. Moreover, parity will only be achieved in the scenario where the proportion of women in the field grows at a decreasing rate.

Study 2: Method

Sample

Our sample consisted of all researchers who have published at least one article in AMJ or JOM from January 2002 to December 2017. The AMJ dataset included 1,814 researchers who published 1,043 articles and of whom 628 (34.6%) were women. The JOM dataset included 1,843 researchers who published 930 articles of whom 568 (30.8%) were women.

Measures and Data Analytic Approach

We used the same measures as in Study 1. Regarding the allometric analysis and test of our hypotheses, we used the exact same procedures as in Study 1 for Hypotheses 1a versus 1b. For the test of Hypotheses 2a versus 2b, we followed the same procedures as in Study 1, but used a different baseline parity target. As described earlier, in Study 1 we chose 44% (i.e., the 2011 female proportion of university-employed SIOP members) as being the 2011 parity target. In Study 2, however, we chose 36.2% as being the 2016 baseline parity target. We chose this baseline estimate because it was the reported share of women among full-time management professors in 2016 (AACSB, 2017). Thus, if women had produced 36.2% of management articles in 2016, we would determine that parity had been achieved then in the field. We then followed the same procedures as in Study 1 to predict when parity would occur in each of the same three scenarios.

Study 2: Results

Descriptive Results

Figure 4 depicts the research productivity of women and men over time in AMJ and JOM. During the 16-year period from January 2002 to December 2017, women produced 30.7% and 29.7% of all authorships in AMJ and JOM, respectively. Thus, women’s share of total output in each journal was smaller than the 2016 parity target of 36.2% (i.e., the proportion of women among full-time management professors in 2016). Table 6 summarizes the year-by-year research productivity counts (and shares) in each journal by each gender.

Test of Hypotheses 1a versus 1b: Is the Gap Narrowing?

Table 7 summarizes results of the allometric regressions based on Equation 5. The R^2 values of the allometric models were .56 for AMJ and .66 for JOM, meaning that (the logarithm of) women's research productivity explains 56% and 66% of the total observed variation in (the logarithm of) men's research productivity in AMJ and JOM, respectively. The predicted R^2 values of the models were .37 for AMJ and .57 for JOM. These values indicate that predictive effectiveness was higher for JOM than AMJ (but lower than JAP for both). In both journals, the scaling exponent alpha (α) was smaller than 1, indicating the presence of an allometric scaling relationship in favor of women (i.e., the non-linear growth rate in research productivity is greater for women than for men in both journals). The alpha value was equal to .44 for AMJ and .49 for JOM, meaning that male productivity scales to female productivity to the power of .44 in AMJ and .49 in JOM. In practical terms, this suggests that if women's authorships within each journal increase by twofold from one year to another, men's would increase by 1.36 fold in AMJ and 1.40 fold in JOM during the same time period. Results thus indicate support for Hypothesis 1a: the gender productivity gap is narrowing.

Test of Hypotheses 2a versus 2b: Is Gender Parity Likely to Occur in the Near Future?

Table 8 summarizes the estimates of women's annual share of total outputs in AMJ and in JOM from 2020 to 2050. As in Study 1, we generated these estimates by fitting exponential trendlines to the observed productivity data points during 2002-2017 and then extending those lines into the future. For example, our findings suggest that, in year 2050, women will produce 41.1% of total output in AMJ and 52.3% of total output in JOM.

Table 9 summarizes predictions for how the parity target will change beyond the 2016 estimate of 36.2%, assuming that the proportion of women (a) grows at a stable rate, (b) grows at a decreasing rate, or (c) grows at an increasing rate. As in Study 1, we overlaid linear, logarithmic, and exponential trendlines to the AACSB's data points regarding women's share of full-time business school faculty, with each trendline representing gender composition change in each of the scenarios. Subsequently, we estimated future parity targets using the assumption that female growth occurs proportionately across management and the business discipline as a whole. For example, in the scenario where the proportion of women in the field grows at a stable rate, we predict that women will comprise 55.1% of all business school faculty and 58.0% of all management researchers by 2050, making 58.0% the parity target for 2050. On the other hand, in the scenario where the proportion of women in the field grows at a decreasing rate, 40.5% was the parity target for 2050. Alternatively, in the scenario where the proportion of women in the field grows at an increasing rate, 73.0% was the parity target for 2050.

Lastly, Table 10 summarizes our estimates regarding when parity will occur in AMJ and JOM. First, we estimated the years in which women's share of total outputs will reach the 2016 parity target of 36.2% as well as a set of discrete percentages, ranging from 50% to 90% and in 10% increments. For example, women are predicted to achieve the 2016 parity target of 36.2% in year 2033 for AMJ and year 2024 for JOM. We also predict that women will produce 50% of annual output in AMJ and JOM in years 2081 and 2047, respectively. Next, we estimated the years in which women's share of total outputs will match the parity target for each of the three scenarios. First, in the scenario where the proportion of women in the field grows at a constant rate, parity will virtually never be reached in each journal, as the parity target will continue to exceed women's share of total outputs until the former (unrealistically) reaches 100%. Second, in the scenario where the proportion of women in the field grows at a decreasing rate, parity is predicted to occur in year 2027 for JOM and not until year 2048 for AMJ. Third, in the scenario where the proportion of women in the field grows at an increasing rate, parity is predicted to virtually never occur. In summary, parity is not predicted to occur earlier than year 2048 for AMJ and year 2027 for JOM. Moreover, parity will only be achieved in the scenario where the proportion of women in the field grows at a decreasing rate.

General Discussion

Based on an examination of cross-sectional data, Aguinis et al. (2018) and others (e.g., Aksnes, Rorstad, Piro, & Sivertsen, 2011; Ceci, Ginther, Kahn, & Williams, 2014; Ginther & Hayes, 2003; McDowell, Singell, & Ziliak, 2001; Odic & Wojcik, 2020; Roy et al., 2020) found a gender research productivity gap in favor of men in applied psychology and other fields. The goal of our study was to use allometric analysis to investigate whether this widely documented gender research productivity gap is widening or narrowing over time, as well as make predictions on whether gender research productivity parity would be achieved in the future and when. Study 1 included 2,600 researchers who published 1,595 articles in JAP and Study 2 included 1,814 researchers who published 1,043 articles in AMJ and 1,843 who published 930 articles in JOM from January 2002 to December 2017. Results were consistent across the two studies and suggested that the gender research productivity gap is narrowing. Paradoxically, however, results also indicated that parity is not predicted to occur anytime in the near future. Specifically, the proportion of women in the fields grows at a constant rate or at an increasing rate, parity will virtually never be achieved. In contrast, if the proportion of women grows at a decreasing rate, parity will be achieved, but not until the year 2027 for JOM, 2048 for AMJ, and 2071 for JAP. Below, we discuss implications for theory and practice based on our findings.

Implications for Current and Future Theory and Research

First, our results generate new insights on the direction and rate of change in the gender research productivity gap. Our analyses revealed that the non-linear growth in annual research outputs was consistently higher for women than for men, although we also found some differences across the three journals. Allometric analysis suggests that in JAP, if women's research outputs increased twofold over a given time period, men's research productivity during the same period would increase by only 1.43. For AMJ, men's productivity would increase by approximately 1.36, and for JOM this value is 1.40. Thus, as a group, women are outpacing men in publications and narrowing the extant productivity gap. In terms of theory, our finding suggest that the historic female disadvantage or "output loss" associated with incremental differentiation, and the Matilda and Matthew effects are gradually diminishing and/or being counterbalanced by other output gains by women as a group. We speculate that this is partly due to rising organizational efforts and resource allocations to reduce gender gaps, and the fact that women are outpacing men in scientific degree attainment and faculty employment (American Academy of Arts and Sciences, 2017; National Science Foundation 2019). In particular, the finding may be explained largely by the rising influx of women in scientific domains, which should cause women's total research output to rise accordingly, ceteris paribus.

Second, our predictions pertaining to parity generate new insights and suggest future research directions regarding the strengths and limitations of current efforts aimed at minimizing gender gaps. Results showed that parity will not be achieved if the proportion of women among researchers rises at a constant rate or at an increasing rate. Under such circumstances, women's average publishing rate will continue to lag behind men's (despite research outputs growing faster for women than men as a group). On the other hand, results predict that parity will eventually be achieved if the proportion of women rises at a decreasing rate; but closing the gender gap in average publishing rates could take from close to a decade to over seven decades, depending on the journal. This finding is a departure from those in other disciplines such nano science and technology, and astrophysics, where women publish at nearly identical rates as men (Roy et al., 2020; Sotudeh & Khoshian, 2014).

Therefore, our results suggest that efforts have been more successful at addressing the *gender representation gap* than the *gender (per capita) productivity gap*. A possible explanation for our paradoxical finding that parity remains elusive while the total gender productivity gap is narrowing could be that institutions are increasingly recruiting and hiring more women despite their publishing less than men on average. This would be consistent with recent evidence that gender biases have in some cases reversed (i.e., in women's favor), especially with regard to hiring and promotion (Breda & Hillion, 2016; Lutter & Schröder, 2016; Madison & Fahlman, 2020; Williams & Ceci, 2015), likely due to increasing institutional adoption of diversity goals (Bonet et al., 2020; Leslie et al., 2017). So perhaps our results are a sign that organizations prioritize addressing the gender representation gap over the productivity gap, and thus allocate more resources toward boosting internal gender balance rather than women's productivity. This is similar to the motivation for using test-score banding in personnel selection with the goal of increasing the representation of ethnic minority members in the workforce, which tries to balance diversity and individual performance goals (Aguinis, 2004). An alternative explanation could be that organizational measures to address the predominant cause of the gender productivity gap are substantially limited compared to those targeting the gender representation gap. For instance, organizations can boost internal gender diversity relatively quickly by, say, implementing gender targets. However, there is no quick method to eliminate covert gender discrimination and subconscious biases in the scientific community. Another possibility is that the growing demand for gender diverse personnel has resulted in disproportionately heightened job competition—and thus greater pressure to publish—facing men relative to women.

Third, while the general pattern of results was consistent across studies, our analyses revealed substantial differences across journals in terms of the rate at which the gender productivity gap is narrowing and when parity may occur. Parity may occur as early as 2027 in JOM, but is not expected to occur until 2048 in AMJ and 2071 in JAP. Given these results, a clear direction for future research is to conduct similar analyses in other journals, including those from outside applied psychology and management, to assess the variation in results. For example, the field of computer sciences, where women's share of bachelor's and doctorate degrees awarded has declined—as opposed to increased—over time (National Science Foundation, 2019) could be a compelling domain for future examination. An examination of additional journals would also lead to possible theory development regarding how and why the gender productivity gap may be narrowing faster in some journals and disciplines compared to others. One possible contributing factor may be variation in the journals' domain focus and breadth of content. According to a topic analysis of over 25,000 management articles, women dominate in research in social- and human-centered areas of management, such as healthcare management and human resource management, whereas men dominate in more technical and operational areas, such as consumer economics and corporate finance (Nielsen & Börjeson, 2019). Hence, one possibility is that certain journals have better content alignment with research topics that are female- versus male-dominated, thus explaining in part why the gender productivity gap is narrowing at varying rates across journals.

Finally, our results help explain some of the contradictory findings from recent literatures regarding gender disparities in scientific domains. One area of contention has to do with whether biases against women remain persistent in academia given that a “female premium” (e.g., Madison & Fahlman, 2020; Williams & Ceci, 2015) contradicts other findings suggesting that women remain substantially disadvantaged (e.g., Moss-Racusin et al., 2012; Sarsons, 2017). Based on our results, it seems that overt gender discrimination (e.g., in hiring and promotion) has likely reduced dramatically given that women are outpacing men in their share of the researcher population and total publications. In other words, it appears that the “pipeline” has become less “leaky.” However, given that gender productivity parity remains elusive, we suggest that covert discrimination (e.g., reduced collaboration interest, reduced credit for coauthored works) and negative stereotypes persist, thus posing constraints on female productivity. We also suggest that differential levels of gender disparity across disciplines, journals, and author rank may have contributed to apparently contradictory results. For example, our finding suggests that gender parity will not be achieved in the near future in the field of applied psychology. But in the field of astronomy, women’s average publishing rate is already within 95% of men’s (Roy et al., 2020); and in the field of nano science and technology, there is no significant gender difference in average productivity (Sotudeh & Khoshian, 2014). The level of gender disparity also varies substantially even across journals from the same discipline, as we found to be the case of AMJ compared to JOM. Furthermore, the level of disparity depends on author rank; for example, in applied psychology, the first-author gender gap has been narrowing while the last-author gender gap remains elusive (Odic & Wojcik, 2020). Thus, while historically women had been severely disadvantaged in scientific careers, they now appear to be disadvantaged to varying extents (i.e., from little or none to substantial), depending on the domain, publication outlet, and other considerations such as author rank.

Implications for Practice

First, our findings suggest that the gender productivity gap is diminishing. On the one hand, this result is promising because female authorship growth in top journals may lead to a chain of consequences affecting the domain in a positive way. For example, increased female representation in high-impact journals may contribute to improved stereotypes regarding women's abilities, alleviate various gender-based productivity constraints (e.g., collaboration opportunities), and attract more female prospective researchers to the field. On the other hand, there is a caveat: women will likely continue to lag behind men in average publishing rate, and parity will likely not be achieved in the near future. This is a disconcerting prospect as it may perpetuate negative stereotypes regarding women's scientific abilities, making it even more challenging to eliminate gender-based productivity constraints. As such, we recommend that organizations allocate greater resources to address the (per capita) gender productivity gap. For example, universities may consider ways to increase fairness in the allocation of teaching and miscellaneous service responsibilities. Additionally, given that women tend to self-cite their previous work less frequently than men (King et al., 2017), organizations could work towards building a culture that encourages women to engage in self-citing and other self-promotion behaviors—and thereby enhance their visibility and reputation—without fear of backlash.

Second, another implication for practice is that organizations should implement objective measures wherever possible when making decisions related to hiring, promotion, funding, and other important outcomes that heavily impact future research productivity. This is important not just for minimizing gender discrimination against women but also instances of "reverse discrimination," where a female candidate may be favored over a more productive male candidate. While hiring more women, for example, helps to boost internal gender diversity, hiring a less productive woman may actually be detrimental to women in the long-run, as it creates an ability gap and, in turn, a productivity gap between female and male researchers. As such, organizations should consider prioritizing initiatives aimed at boosting, or de-constraining, female productivity. Otherwise, gender productivity parity will likely remain unattainable. Meanwhile, organizations should also perform the balancing act of attracting more female talent while also taking measures to ensure neither women nor men are favored over another in important decisions such as hiring and promotion.

Limitations and Additional Future Research Directions

First, we only assessed three journals across two disciplines. As mentioned earlier, we initially considered also including *Personnel Psychology*. However, the journal publishes approximately only 25 articles per year, which resulted in the sample being too small to produce reliable results. Furthermore, given the paucity of women in applied psychology before 2002 (i.e., there were even fewer women in the field in the 1990s and earlier; Gardner et al., 2018), we concluded that widening the time window would not provide additional meaningful and informative data. While we acknowledge our use of three journals as a potential limitation, past research examining additional journals did not yield results substantially different from those from JAP (e.g., Treviño, Gomez-Mejia, Balkin, & Mixon, Jr., 2015). Nonetheless, future studies could investigate other journals as well as other disciplines.

Second, we made several explicit and open assumptions to make predictions regarding when parity would occur. We first made the assumption that annual research productivity would grow at an exponential rate. This may be a strong assumption, given that, currently, many journals have an upper limit of sorts in the number of articles they produce in a given year, meaning that they may not be able to accommodate an exponential growth in research output.

However, given the movement towards online publishing rather than printing, in the future there may be virtually no limit on publishing rates in most journals. A large number of scientific journals have already embraced the online-only model, such as *BMC Medicine*, *Genetics*, and *Nature Human Behavior*, and many journals now publish articles on a weekly or per-acceptance basis. Next, we made the assumption that the proportion of women in the applied psychology field grows proportionately to that of full-time faculty in business schools. While the rate of female growth has indeed been similar across applied psychology and business in the past several decades, there is uncertainty regarding whether that will continue to be the case in the future. In addition, we estimated the proportion of women in each field using proxies: for applied psychology, we used the 2011 reported share of women among university-employed SIOP members for the field of applied psychology, and for management, we used the 2016 reported share of women among full-time management professors. As such, there is uncertainty regarding how accurately these figures represent the actual proportion of women in each field. In our analysis, we aimed to address these uncertainties by making separate predictions based on three scenarios regarding the female proportion and growth in each field. Also, given recent concerns about replicability and the need "to increase the transparency and reproducibility of our science" (Eby, 2020), we made our assumptions fully explicit and open and reported detailed results based on each.

Concluding Remarks

We examined gender differences in the research productivity growth of all researchers who had published at least one article in applied psychology (Study 1) and management (Study 2) from 2002 to 2017. Our analyses revealed a significant allometric scaling relationship between female and male productivity. Specifically, the non-linear growth in productivity was greater for women than for men in all three journals. As such, we conclude that the total gender productivity gap is narrowing in the fields of applied psychology and management. Paradoxically, however, our findings suggest that gender productivity parity (i.e., the point at which women's share of research output matches the proportion of women in the field) remains elusive. Assuming that the proportion of women in the field grows at a constant rate or at an increasing rate, parity will virtually never be achieved. In each circumstance, women's share of research outputs, despite outpacing men's, will never catch up to the proportion of women in the field. In other words, women will continue to lag behind men in average publishing rate. In contrast, assuming that the proportion of women in the field grows at a decreasing rate, parity will be reached, but this may take several decades depending on the particular discipline and journal—specifically, parity is predicted to occur in in the year 2027 for JOM, 2048 for AMJ, and 2071 for JAP. Taken together, our results suggest that organizations and society at large have made substantial progress in enhancing female scientific participation, but less so in terms of boosting female productivity. Promoting female scientific participation is certainly important. However, simply producing and attracting more female scholars may lead to other unintended negative consequences if women continue to lag behind men in average publishing rates. Overall, our findings highlight the urgent need for new measures and greater resource allocation aimed at minimizing real and perceived barriers and constraints that prevent the narrowing of the per-capita gender productivity gap.

References

AACSB International. (2017). 2017 Business School Data Guide. Tampa, FL: Association to Advance Collegiate Schools of Business. https://www.aacsb.edu/data/data-reports/data-guide

AACSB International (2004-2017). Business school questionnaires from 2004 through 2017. Tampa, FL: The Association to Advance Collegiate Schools of Business. https://www.aacsb.edu/data/data-reports/data-guide

Aguinis, H. (Ed.). (2004). *Test-score banding in human resource selection: Legal, technical, and societal issues*. Praeger.

Aguinis, H., Ji, Y. H., & Joo, H. (2018). Gender productivity gap among star performers in STEM and other scientific fields. *Journal of Applied Psychology*, *103*(12), 1283-1306. https://doi.org/10.1037/apl0000331

Aguinis, H., O'Boyle, E., Gonzalez-Mulé, E., & Joo, H. (2016). Cumulative advantage: Conductors and insulators of heavy-tailed productivity distributions and productivity stars. *Personnel Psychology*, *69*(1), 3-66. https://doi.org/10.1111/peps.12095

Aksnes, D. W., Rorstad, K., Piro, F., & Sivertsen, G. (2011). Are female researchers less cited? A large-scale study of Norwegian scientists. *Journal of the American Society for Information Science and Technology*, *62*(4), 628-636. https://doi.org/10.1002/asi.21486

Allison, P., Long, J., & Krauze, T. (1982). Cumulative advantage and inequality in science. *American Sociological Review*, *47*(5), 615-625. https://dx.doi.org/10.2307/2095162

American Academy of Arts and Sciences, Humanities indicators (2017). Gender distribution of advanced degrees in the humanities. https://www.humanitiesindicators.org/content/indicatordoc.aspx?i=47

Amo, L. C., Ada, S., & Sharman, R. (2012). The role of scholar status in the academic publication process. *International Journal of Doctoral Studies*, *7*, 79-92. https://doi.org/10.28945/1564

Azoulay, P., Stuart, T., & Wang, Y. (2013). Matthew: Effect or fable? *Management Science*, *60*(1), 92-109. https://doi.org/10.1287/mnsc.2013.1755

Baumert, J., Nagy, G., & Lehmann, R. (2012). Cumulative advantages and the emergence of social and ethnic inequality: Matthew effects in reading and mathematics development within elementary schools? *Child Development*, *83*(4), 1347-1367. https://doi.org/10.1111/j.1467-8624.2012.01779.x

Beck, J. W., Beatty, A. S., & Sackett, P. R. (2014). On the distribution of job performance: The role of measurement characteristics in observed departures from normality. *Personnel Psychology*, *67*(3), 531-566. https://doi.org/10.1111/peps.12060

Bentley, P. (2012). Gender differences and factors affecting publication productivity among Australian university academics. *Journal of Sociology*, *48*(1), 85-103. https://doi.org/10.1177/1440783311411958

Bonet, R., Cappelli, P., & Hamori, M. (2020). Gender differences in speed of advancement: An empirical examination of top executives in the Fortune 100 firms. *Strategic Management Journal*, *41*(4), 708-737. https://doi.org/10.1002/smj.3125

Bradford, S. C. (1946). *Documentation*. London: Crosby Lockwood.

Breda, T., & Hillion, M. (2016). Teaching accreditation exams reveal grading biases favor women in male-dominated disciplines in France. *Science*, *353*(6298), 474-478. https://doi.org/10.1126/science.aaf4372

Brookes, B. C. (1969). Bradford's law and the bibliography of science. *Nature*, *224*(5223), 953-956.https://doi.org/10.1038/224953a0

Carli, L. L., Alawa, L., Lee, Y., Zhao, B., & Kim, E. (2016). Stereotypes about gender and science: Women ≠ scientists. *Psychology of Women Quarterly*, *40*(2), 244-260. https://doi.org/10.1177/0361684315622645

Ceci, S. J., Ginther, D. K., Kahn, S., & Williams, W. M. (2014). Women in academic science: A changing landscape. *Psychological Science in the Public Interest*, *15*(3), 75-141. https://doi.org/10.1177/1529100614541236

Chesler, N. C., Barabino, G., Bhatia, S. N., & Richards-Kortum, R. (2010). The pipeline still leaks and more than you think: a status report on gender diversity in biomedical engineering. *Annals of biomedical engineering*, *38*(5), 1928-1935. https://doi.org/10.1007/s10439-010-9958-9

Cole, S., & Cole, J. R. (1967). Scientific output and recognition: A study in the operation of the reward system in science. *American sociological review*, *32*(3), 377-390. https://doi.org/10.2307/2091085

Cole, J. R., & Zuckerman, H. (1984). The productivity puzzle: persistence and change in patterns of publications of men and women scientists. In M. W. Steinkamp & M. L. Maehr (Eds.), *Advances in Motivation and Achievement* (Vol. 2, pp. 217-258). JAI Press.

de Solla-Price, D. J. (1965). Networks of scientific papers. *Science, 149*(3683), 510-515. https://doi.org/10.1126/science.149.3683.510

Diekman, A. B., Weisgram, E. S., & Belanger, A. L. (2015). New routes to recruiting and retaining women in STEM: Policy implications of a communal goal congruity perspective. *Social Issues and Policy Review, 9*(1), 52-88. https://doi.org/10.1111/sipr.12010

DiPrete, T. A., & Eirich, G. M. (2006). Cumulative advantage as a mechanism for inequality: A review of theoretical and empirical developments. *Annual Review of Sociology, 32*, 271 -297. https://doi.org/10.1146/annurev.soc.32.061604.123127

Eagly, A. H., & Karau, S. J. (2002). Role congruity theory of prejudice toward female leaders. *Psychological review*, *109*(3), 573. https://doi.org/10.1037/0033-295X.109.3.573

Eagly, A. H., & Miller, D. I. (2016). Scientific eminence: Where are the women? *Perspectives on Psychological Science*, *11*(6), 899-904. https://doi.org/10.1177/1745691616663918

Eby, L. (2020). Editor spotlight. https://www.apa.org/pubs/highlights/editor-spotlight/apl-eby

Feldon, D. F., Maher, M. A., Roksa, J., & Peugh, J. (2016). Cumulative advantage in the skill development of STEM graduate students: a mixed-methods study. *American Educational Research Journal*, *53*(1), 132-161. https://doi.org/10.3102/0002831215619942

Gardner, D., Ryan, A., & Snoeyink, M. (2018). How are we doing? An examination of gender representation in industrial and organizational (I-O) psychology. *Industrial and Organizational Psychology, 11*(3), 369-388. https://doi.org/10.1017/iop.2018.4

Ginther, D. K., & Hayes, K. J. (2003). Gender differences in salary and promotion for faculty in the humanities 1977–95. *Journal of Human Resources, 38*(1), 34-73. https://doi.org/10.3368/jhr.XXXVIII.1.34

Halpern, D. F., Benbow, C. P., Geary, D. C., Gur, R. C., Hyde, J. S., & Gernsbacher, M. A. (2007). The science of sex differences in science and mathematics. *Psychological Science in the Public Interest, 8*(1), 1-51. https://doi.org/10.1111/j.1529-1006.2007.00032.x

Headworth, S., & Freese, J. (2015). Credential privilege or cumulative advantage? Prestige, productivity, and placement in the academic sociology job market. *Social Forces*, *94*(3), 1257-1282. https://doi.org/10.1093/sf/sov102

Highhouse, S., Zickar, M., & Melick, S. (in press). Prestige and relevance of the scholarly journals: Impressions of SIOP members. *Industrial and Organizational Psychology*. https://doi.org/10.1017/iop.2020.2

Horta, H., & Santos, J. M. (2016). The impact of publishing during PhD studies on career research publication, visibility, and collaborations. *Research in Higher Education*, *57*(1), 28-50. https://doi.org/10.1007/S11162-015-9380-0

Huxley, J. S. (1923). *Problems of Relative Growth*. London: Methuen & Co. LTD.

Joo, H., Aguinis, H., & Bradley, K. J. (2017). Not all nonnormal distributions are created equal: Improved theoretical and measurement precision. *Journal of Applied Psychology, 102*(7), 1022-1053. https://doi.org/10.1037/apl0000214

Judge, T. A., & Hurst, C. (2008). How the rich (and happy) get richer (and happier): relationship of core self-evaluations to trajectories in attaining work success. *Journal of Applied Psychology*, *93*(4), 849-863. https://doi.org/10.1037/0021-9010.93.4.849

Katz, J. S. (2005). Scale-independent bibliometric indicators. *Measurement: Interdisciplinary Research and Perspectives, 3*(1), 24-28. https://doi.org/10.1207/s15366359mea0301_3

King, M. M., Bergstrom, C. T., Correll, S. J., Jacquet, J., & West, J. D. (2017). Men set their own cites high: Gender and self-citation across fields and over time. *Socius*, *3*, 1-22. https://doi.org/10.1177/2378023117738903

Kleiber, M. (1932). Body size and metabolism. *Hilgardia, 6*(11), 315-353. https://doi.org/10.1152/physrev.1947.27.4.511

Knobloch-Westerwick, S., Glynn, C. J., & Huge, M. (2013). The Matilda effect in science communication: An experiment on gender bias in publication quality perceptions and collaboration interest. *Science Communication*, *35*(5), 603-625. https://doi.org/10.1177/1075547012472684

Kozlowski, S. W. J., Chen, G., & Salas, E. (2017). One hundred years of the *Journal of Applied Psychology*: Background, evolution, and scientific trends. *Journal of Applied Psychology, 102*(3), 237-253.

Leslie, L. M., Manchester, C. F., & Dahm, P. C. (2017). Why and when does the gender gap reverse? Diversity goals and the pay premium for high potential women. *Academy of Management Journal*, *60*, 402-432. https://doi.org/10.1037/apl0000192

Lincoln, A. E., Pincus, S., Koster, J. B., & Leboy, P. S. (2012). The Matilda effect in science: Awards and prizes in the US, 1990s and 2000s. *Social studies of science*, *42*(2), 307-320. https://doi.org/10.1177/0306312711435830

Lortie, C. J., Aarssen, L. W., Budden, A. E., Koricheva, J. K., Leimu, R., & Tregenza, T. (2007).

Publication bias and merit in ecology. *Oikos, 116*(7), 1247-1253. https://doi.org/10.1111/j.0030-1299.2007.15686.x

Lutter, M., & Schröder, M. (2016). Who becomes a tenured professor, and why? Panel data evidence from German sociology, 1980–2013. *Research Policy, 45*(5), 999-1013. https://doi.org/10.1016/j.respol.2016.01.019

Madison, G., & Fahlman, P. (2020). Sex differences in the number of scientific publications and citations when attaining the rank of professor in Sweden. *Studies in Higher Education*, 1 -22. https://doi.org/10.1080/03075079.2020.1723533

McDowell, J. M., Singell Jr, L. D., & Ziliak, J. P. (2001). Gender and promotion in the economics profession. *ILR Review, 54*(2), 224-244. https://doi.org/10.1177/001979390105400202

McGuire, S. P., & Creamer, E. G. (1998). Applying the cumulative advantage perspective to scholarly writers in higher education. *The Review of Higher Education*, *22*(1), 73-82. https://doi.org/10.1353/rhe.1998.0020

Merton, R. K. (1968). The Matthew effect in science. *Science, 159*(3810), 56-63. https://doi.org/10.1126/science.159.3810.56

Moss-Racusin, C. A., Dovidio, J. F., Brescoll, V. L., Graham, M. J., & Handelsman, J. (2012). Science faculty's subtle gender biases favor male students. *Proceedings of the National Academy of Sciences of the United States of America*, *109*(41), 16474–16479. https://doi.org/10.1073/pnas.1211286109

Naranan, S. (1989). "Power law" version of Bradford law: Statistical tests and methods of estimation. *Scientometrics, 17*(3-4), 211-226. https://doi.org/10.1007/bf02026411

National Science Foundation. (2019). Women, minorities, and persons with disabilities in science and engineering: 2019. https://ncses.nsf.gov/pubs/nsf19304/digest/

Nielsen, M. W., & Börjeson, L. (2019). Gender diversity in the management field: Does it matter for research outcomes?. *Research Policy*, *48*(7), 1617-1632. https://doi.org/10.1016/j.respol.2019.03.006

Odic, D., & Wojcik, E. H. (2020). The publication gender gap in psychology. *American Psychologist*, *75*(1), 92. https://doi.org/10.1037/amp0000480

Paswan, J., & Singh, V. K. (2020). Gender and research publishing analyzed through the lenses of discipline, institution types, impact and international collaboration: a case study from India. *Scientometrics, 123*, 1-19. https://doi.org/10.1007/s11192-020-03398-5

Petersen, A. M., Fortunato, S., Pan, R. K., Kaski, K., Penner, O., Rungi, A., & Pammolli, F. (2014). Reputation and impact in academic careers. *Proceedings of the National Academy of Sciences*, *111*(43), 15316-15321. https://doi.org/10.1073/pnas.1323111111

Reuben, E., Sapienza, P., & Zingales, L. (2014). How stereotypes impair women's careers in science. *Proceedings of the National Academy of Sciences of the United States of America, 111*(12), 4403-4408. https://doi.org/10.1073/pnas.1314788111

Ronda-Pupo, G. A. (2017). The citation-based impact of complex innovation systems scales with the size of the system. *Scientometrics, 112*(1), 141-151. https://doi.org/10.1007/s11192-017-2401-3

Rossiter, M. W. (1993). The Matthew effect in science. *Social Studies of Science, 23*(2), 325-341. https://doi.org/10.1177/030631293023002004

Roy, Marie-Françoise, Guillopé, Colette, Cesa, Mark, Ivie, Rachel, White, Susan, Mihaljevic, Helena, …Chiu, Mei-Hung. (2020, March 4). *A Global Approach to the Gender Gap in Mathematical, Computing, and Natural Sciences. How to Measure It, How to Reduce It?*. Zenodo. https://doi.org/10.5281/zenodo.3697222

Sahal, D. (1981). *Patterns of technological innovation*. New York: Addison-Wesley.

Sarsons, H. (2017). Recognition for group work: Gender differences in academia. *The American Economic Review, 107*(5), 141-145. http://doi.org/10.1257/aer.p20171126

Sotudeh, H., & Khoshian, N. (2014). Gender differences in science: the case of scientific productivity in Nano Science & Technology during 2005–2007. *Scientometrics, 98*(1), 457-472. https://doi.org/10.1007/s11192-013-1031-7

Tenenbaum, H. R., & Leaper, C. (2003). Parent-child conversations about science: The socialization of gender inequities? *Developmental Psychology, 39*(1), 34-47. https://doi.org/10.1037/0012-1649.39.1.34

Treviño, L. J., Gomez-Mejia, L. R., Balkin, D. B., & Mixon Jr, F. G. (2018). Meritocracies or masculinities? The differential allocation of named professorships by gender in the academy. *Journal of Management*, *44*(3), 972-1000. https://doi.org/10.1177/0149206315599216 van Arensbergen, P., van der Weijden, I., & Van den Besselaar, P. (2012). Gender differences in scientific productivity: a persisting phenomenon?. *Scientometrics*, *93*(3), 857-868. https://doi.org/10.1007/s11192-012-0712-y

Van Den Besselaar, P., & Sandström, U. (2016). Gender differences in research performance and its impact on careers: a longitudinal case study. *Scientometrics*, *106*(1), 143-162. http://doi.org/10.1007/s11192-015-1775-3

Vancouver, J. B., Li, X., Weinhardt, J. M., Steel, P., & Purl, J. D. (2016). Using a computational model to understand possible sources of skews in distributions of job performance. *Personnel Psychology*, *69*(4), 931-974. https://doi.org/10.1111/peps.12141

West, G. B., Brown, J. H., & Enquist, B. J. (1997). A general model for the origin of allometric scaling laws in biology. *Science*, *276*(5309), 122-126. https://doi.org/10.1126/science.276.5309.122

Williams, W. M., & Ceci, S. J. (2015). National hiring experiments reveal 2: 1 faculty preference for women on STEM tenure track. *Proceedings of the National Academy of Sciences*, *112*(17), 5360-5365. https://doi.org/10.1073/pnas.1418878112

Willson, A. E., Shuey, K. M., & Elder, Jr, G. H. (2007). Cumulative advantage processes as mechanisms of inequality in life course health. *American Journal of Sociology*, *112*(6), 1886-1924. https://doi.org/10.1086/512712

Xie, Y., & Shauman, K. A. (2003). *Women in science: Career processes and outcomes*. Cambridge, MA: Harvard University Press.

Table 1
Annual Research Productivity (i.e., Authorship Counts) of Women and Men in Journal of Applied Psychology (2002-2017)

Publication Year	**Women (*N* = 1,068)**	**Men (*N* = 1,532)**
2002	120 (36.4%)	210 (63.6%)
2003	81 (31.5%)	176 (68.5%)
2004	82 (31.7%)	177 (68.3%)
2005	87 (31.3%)	191 (68.7%)
2006	98 (30.7%)	221 (69.3%)
2007	153 (35.7%)	275 (64.3%)
2008	120 (37.2%)	203 (62.8%)
2009	117 (33.9%)	228 (66.1%)
2010	98 (38.6%)	156 (61.4%)
2011	110 (35.4%)	201 (64.6%)
2012	105 (37.4%)	176 (62.6%)
2013	84 (32.4%)	175 (67.6%)
2014	93 (33.1%)	188 (66.9%)
2015	163 (40.0%)	245 (60.0%)
2016	142 (35.9%)	254 (64.1%)
2017	123 (35.7%)	222 (64.3%)
Average	111 (35.0%)	206 (65.0%)

Note: Values in parentheses represent each gender's share of total research productivity (i.e., percentage of total authorships) in a given year.

Table 2

Allometric Regression Results for Study 1: Journal of Applied Psychology

α (*SE*)	***t***	**R^2**	**Predicted R^2**
.52 (.09)	5.72*	.69	.62

Note: α = Scaling exponent (see Equation 4); *SE* = Standard error of the exponent; * $p < .001$.

Table 3

Women's Predicted Share of Total Research Outputs in Journal of Applied Psychology

Year	**Predicted Share of JAP Authorships**
2020	37.5%
2022	38.0%
2024	38.5%
2026	39.1%
2028	39.6%
2030	40.1%
2032	40.7%
2034	41.2%
2036	41.8%
2038	42.3%
2040	42.9%
2042	43.4%
2044	44.0%
2046	44.5%
2048	45.1%
2050	45.7%

Table 4

Predictions Regarding Future Gender Parity in Research Productivity based on Three Scenarios

Year		Proportion of Women Among Full-Time Business School Faculty [a]			Proportion of Women in Applied Psychology [b]		
Observed Years	2004	25.1%			44% in 2011[a]		
	2005	25.2%					
	2006	26.0%					
	2007	27.8%					
	2008	28.7%					
	2009	28.5%					
	2010	29.2%					
	2011	29.6%					
	2012	30.1%					
	2013	30.6%					
	2014	32.0%					
	2015	31.7%					
	2016	33.6%					
	2017	34.5%					
		Proportion of Women Among Full-Time Business School Faculty			**Proportion of Women in Applied Psychology**		
Assuming female growth is…		*Scenario 1: Linear*	*Scenario 2: Logarithmic*	*Scenario 3: Exponential*	*Scenario 1: Linear*	*Scenario 2: Logarithmic*	*Scenario 3: Exponential*
Predicted Years	2020	34.6%	32.6%	34.9%	48.8%	46.2%	49.2%
	2022	36.0%	33.1%	36.6%	50.1%	46.6%	50.9%
	2024	37.3%	33.5%	38.3%	51.5%	47.0%	52.7%
	2026	38.7%	33.8%	40.2%	52.9%	47.4%	54.5%
	2028	40.1%	34.1%	42.1%	54.2%	47.7%	56.4%
	2030	41.4%	34.4%	44.1%	55.6%	48.0%	58.4%
	2032	42.8%	34.7%	46.2%	57.0%	48.2%	60.5%
	2034	44.1%	34.9%	48.4%	58.3%	48.5%	62.7%
	2036	45.5%	35.2%	50.7%	59.7%	48.7%	65.0%
	2038	46.9%	35.4%	53.1%	61.1%	48.9%	67.4%
	2040	48.2%	35.6%	55.6%	62.4%	49.1%	69.9%
	2042	49.6%	35.8%	58.3%	63.8%	49.3%	72.6%
	2044	51.0%	36.0%	61.0%	65.2%	49.5%	75.4%
	2046	52.3%	36.1%	63.9%	66.5%	49.7%	78.3%
	2048	53.7%	36.3%	67.0%	67.9%	49.9%	81.3%
	2050	55.1%	36.5%	70.2%	69.3%	50.0%	84.5%

Note. [a] AACSB (2004-2017). [b] Gardner et al. 2018.

Table 5

Years when Gender Productivity Parity is Predicted to Occur for Journal of Applied Psychology

Parity target		**Predicted Year of Parity**
	44% (2011 parity target)[a]	2045 (44.3%)
	50%	2066 (50.2%)
Women's share of total JAP authorships equals…	60%	2102 (60.2%)
	70%	2141 (70.1%)
	80%	2189 (80.1%)
	90%	2261 (90.1%)
Women's share of total JAP authorships matches the proportion of women in the field, assuming that the latter…	Grows at a decreasing rate	2071 (51.6%)
	Grows at a constant rate	Never
	Grows at an increasing rate	Never

Note: [a] Gardner et al. (2018). Values in parentheses represent women's predicted share of total annual authorships in JAP.

Table 6

Summary of the Annual Research Productivity of Women and Men in Academy of Management Journal and Journal of Management (2002-2017)

	Academy of Management Journal		**Journal of Management**	
Publication Year	Women (*N* = 628)	Men (*N* = 1,186)	Women (*N* = 568)	Men (*N* = 1,275)
2002	58 (31.0%)	129 (69.0%)	26 (35.1%)	48 (64.9%)
2003	39 (34.8%)	73 (65.2%)	21 (19.8%)	85 (80.2%)
2004	39 (25.2%)	116 (74.8%)	23 (24.5%)	71 (75.5%)
2005	49 (30.2%)	113 (69.8%)	19 (20.4%)	74 (79.6%)
2006	42 (27.6%)	110 (72.4%)	27 (27.8%)	70 (72.2%)
2007	54 (33.8%)	106 (66.3%)	22 (26.8%)	60 (73.2%)
2008	35 (23.0%)	117 (77.0%)	32 (30.2%)	74 (69.8%)
2009	41 (27.3%)	109 (72.7%)	47 (36.2%)	83 (63.8%)
2010	48 (30.2%)	111 (69.8%)	38 (28.6%)	95 (71.4%)
2011	47 (30.7%)	106 (69.3%)	41 (25.6%)	119 (74.4%)
2012	49 (29.0%)	120 (71.0%)	44 (27.5%)	116 (72.5%)
2013	62 (30.0%)	145 (70.0%)	68 (37.6%)	113 (62.4%)
2014	61 (30.3%)	140 (69.7%)	56 (32.2%)	118 (67.8%)
2015	72 (33.8%)	141 (66.2%)	58 (25.9%)	166 (74.1%)
2016	72 (28.9%)	177 (71.1%)	70 (36.8%)	120 (63.2%)
2017	104 (40.0%)	156 (60.0%)	77 (30.7%)	174 (69.3%)
Average	55 (30.7%)	123 (69.3%)	42 (29.7%)	99 (70.3%)

Note: Values in parentheses represent each gender’s share of total research productivity (i.e., percentage of total authorships) in a given year and journal.

Table 7

Allometric Regression Results for Study 2: Academy of Management Journal (AMJ) and Journal of Management (JOM)

Journal	α **(*SE*)**	***t***	R^2	**Predicted** R^2
AMJ	.44 (.10)	4.26*	.56	.37
JOM	.49 (.09)	5.23*	.66	.57

Note: α = Scaling exponent (see Equation 4); *SE* = Standard error of the exponent; * $p < .001$.

Table 8
Women's Predicted Share of Total Research Outputs in Academy of Management Journal (AMJ) and Journal of Management (JOM)

Year	Predicted Share of AMJ Authorships	Predicted Share of JOM Authorships
2020	32.9%	34.4%
2022	33.4%	35.5%
2024	34.0%	36.6%
2026	34.5%	37.8%
2028	35.0%	39.0%
2030	35.6%	40.1%
2032	36.1%	41.3%
2034	36.6%	42.5%
2036	37.2%	43.7%
2038	37.7%	45.0%
2040	38.3%	46.2%
2042	38.9%	47.4%
2044	39.4%	48.6%
2046	40.0%	49.9%
2048	40.6%	51.5%
2050	41.1%	52.3%

Table 9

Predictions Regarding Future Gender Parity in Research Productivity in Management based on Three Scenarios

Year		Proportion of Women Among Full-Time Business School Faculty			Proportion of Women in Management		
Observed Years	2004	25.1%					
	2005	25.2%					
	2006	26.0%					
	2007	27.8%					
	2008	28.7%					
	2009	28.5%					
	2010	29.2%					
	2011	29.6%					
	2012	30.1%					
	2013	30.6%					
	2014	32.0%					
	2015	31.7%					
	2016	33.6%				36.2% in 2016[a]	
	2017	34.5%					
		Proportion of Women Among Full-Time Business School Faculty			**Proportion of Women in Management**		
Assuming female growth is…		*Scenario 1: Linear*	*Scenario 2: Logarithmic*	*Scenario 3: Exponential*	*Scenario 1: Linear*	*Scenario 2: Logarithmic*	*Scenario 3: Exponential*
Predicted Years	2020	34.6%	32.6%	34.9%	37.6%	36.7%	37.8%
	2022	36.0%	33.1%	36.6%	38.9%	37.1%	39.5%
	2024	37.3%	33.5%	38.3%	40.3%	37.5%	41.2%
	2026	38.7%	33.8%	40.2%	41.7%	37.9%	43.0%
	2028	40.1%	34.1%	42.1%	43.0%	38.2%	44.9%
	2030	41.4%	34.4%	44.1%	44.4%	38.5%	46.9%
	2032	42.8%	34.7%	46.2%	45.8%	38.7%	49.0%
	2034	44.1%	34.9%	48.4%	47.1%	39.0%	51.2%
	2036	45.5%	35.2%	50.7%	48.5%	39.2%	53.5%
	2038	46.9%	35.4%	53.1%	49.8%	39.4%	55.9%
	2040	48.2%	35.6%	55.6%	51.2%	39.7%	58.5%
	2042	49.6%	35.8%	58.3%	52.6%	39.8%	61.1%
	2044	51.0%	36.0%	61.0%	53.9%	40.0%	63.9%
	2046	52.3%	36.1%	63.9%	55.3%	40.2%	66.8%
	2048	53.7%	36.3%	67.0%	56.7%	40.4%	69.8%
	2050	55.1%	36.5%	70.2%	58.0%	40.5%	73.0%

Note. [a] AACSB (2017).

Table 10

Years when Gender Parity in Research Productivity Parity is Predicted to Occur in Academy of Management Journal (AMJ) and Journal of Management (JOM)

Parity target		**Predicted Year of Parity in AMJ**	**Predicted Year of Parity in JOM**
Women's share of total authorships in the journal equals…	36.2% (2016 parity target)[a]	2033 (36.4%)	2024 (36.7%)
	50%	2081 (50.2%)	2047 (50.5%)
	60%	2115 (60.0%)	2063 (60.2%)
	70%	2153 (70.2%)	2081 (70.2%)
	80%	2199 (80.2%)	2103 (80.2%)
	90%	2267 (90.0%)	2136 (90.1%)
Women's share of total authorships in the journal matches the proportion of women in the field, assuming that the latter…	Grows at a decreasing rate	2048 (40.6%)	2027 (38.4%)
	Grows at a constant rate	Never	Never
	Grows at an increasing rate	Never	Never

Note. [a] AACSB (2017). Values in parentheses represent women's predicted share of total annual authorships in a given journal.

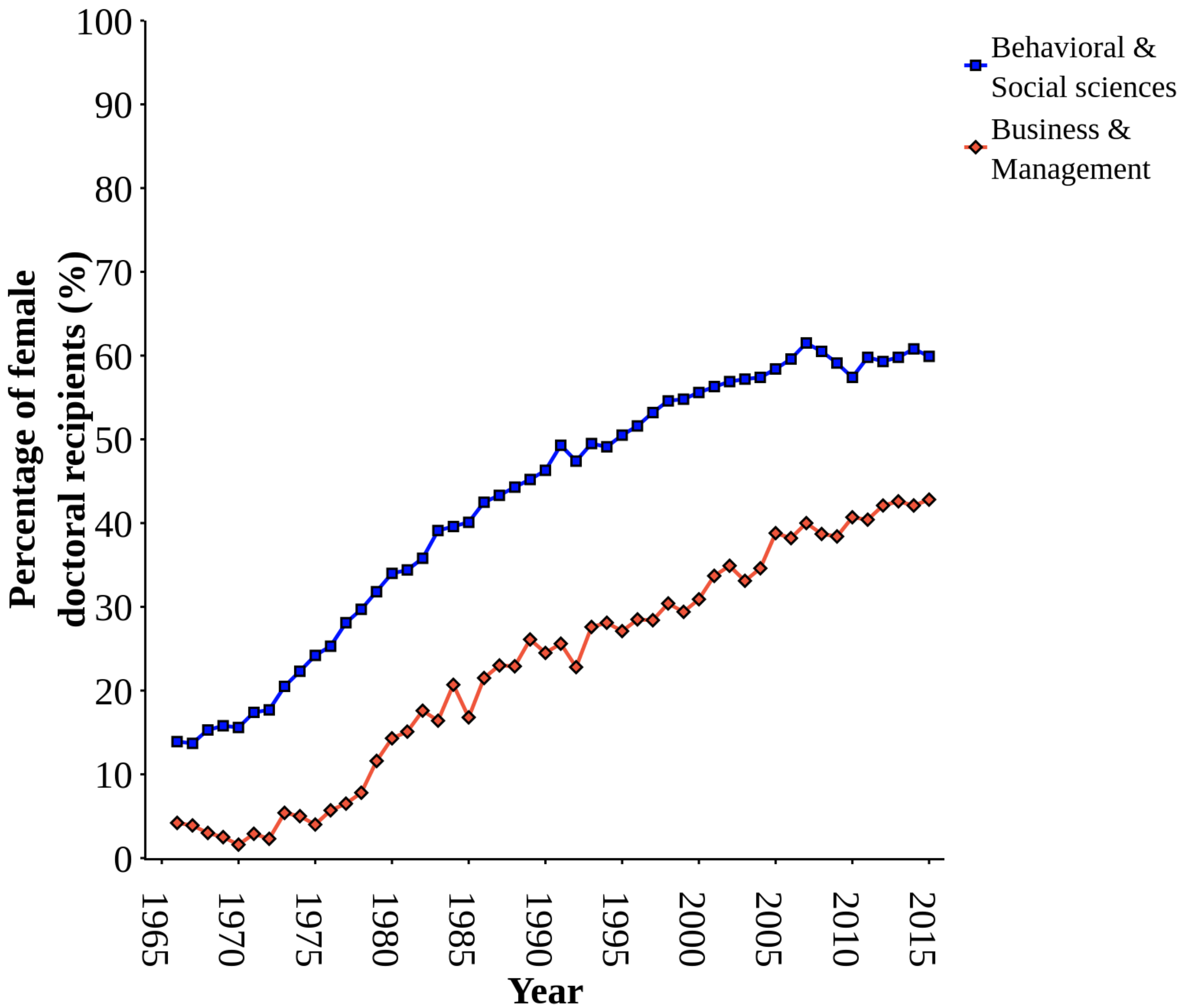

Figure 1. Chart depicting women's share of PhDs conferred annually in the fields of (1) behavioral and social sciences (which includes applied psychology) and (2) business and management from 1965 to 2015 (American Academy of Arts and Sciences, 2017).

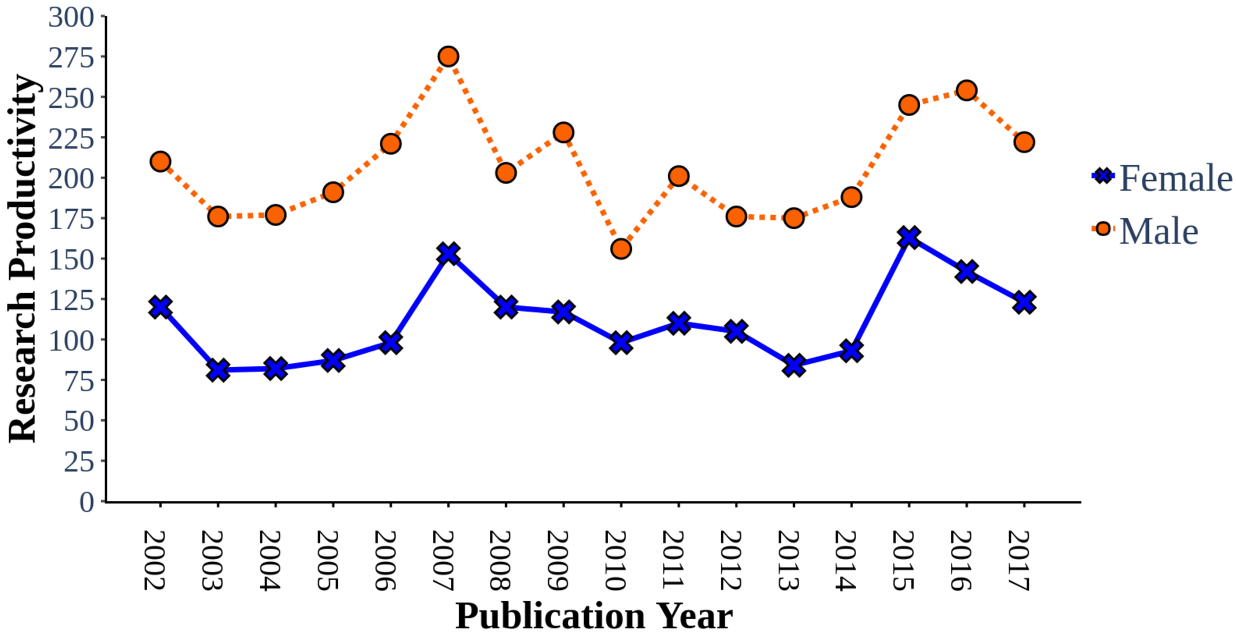

Figure 2. Chart depicting each gender's annual research productivity (i.e., authorship counts) in Journal of Applied Psychology (2002-2017).

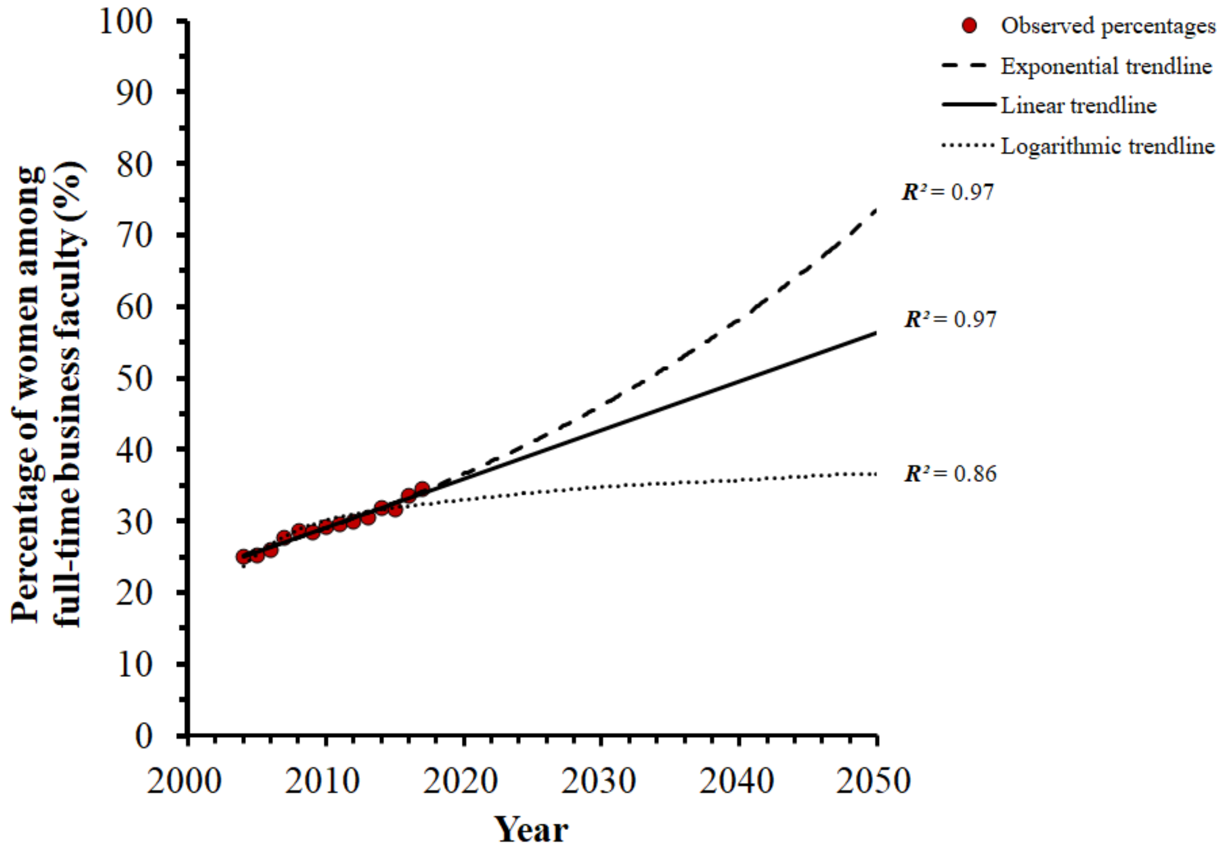

Figure 3. Chart depicting the observed and predicted percentages of women among full-time business faculty over time. Circles represent observed percentages in each year from 2004 to 2017. Lines represent predicted percentages based on the following three scenarios: the percentage of women (a) grows at a constant rate, (b) grows at a decreasing rate, and (c) grows at an increasing rate. The linear trendline (solid) represents the first scenario that assumes female growth occurs at a constant rate. The logarithmic trendline (dotted) represents the second scenario that assumes female growth occurs at a decreasing rate. The exponential trendline (dashed) represents the third scenario that assumes female growth occurs at an increasing rate.

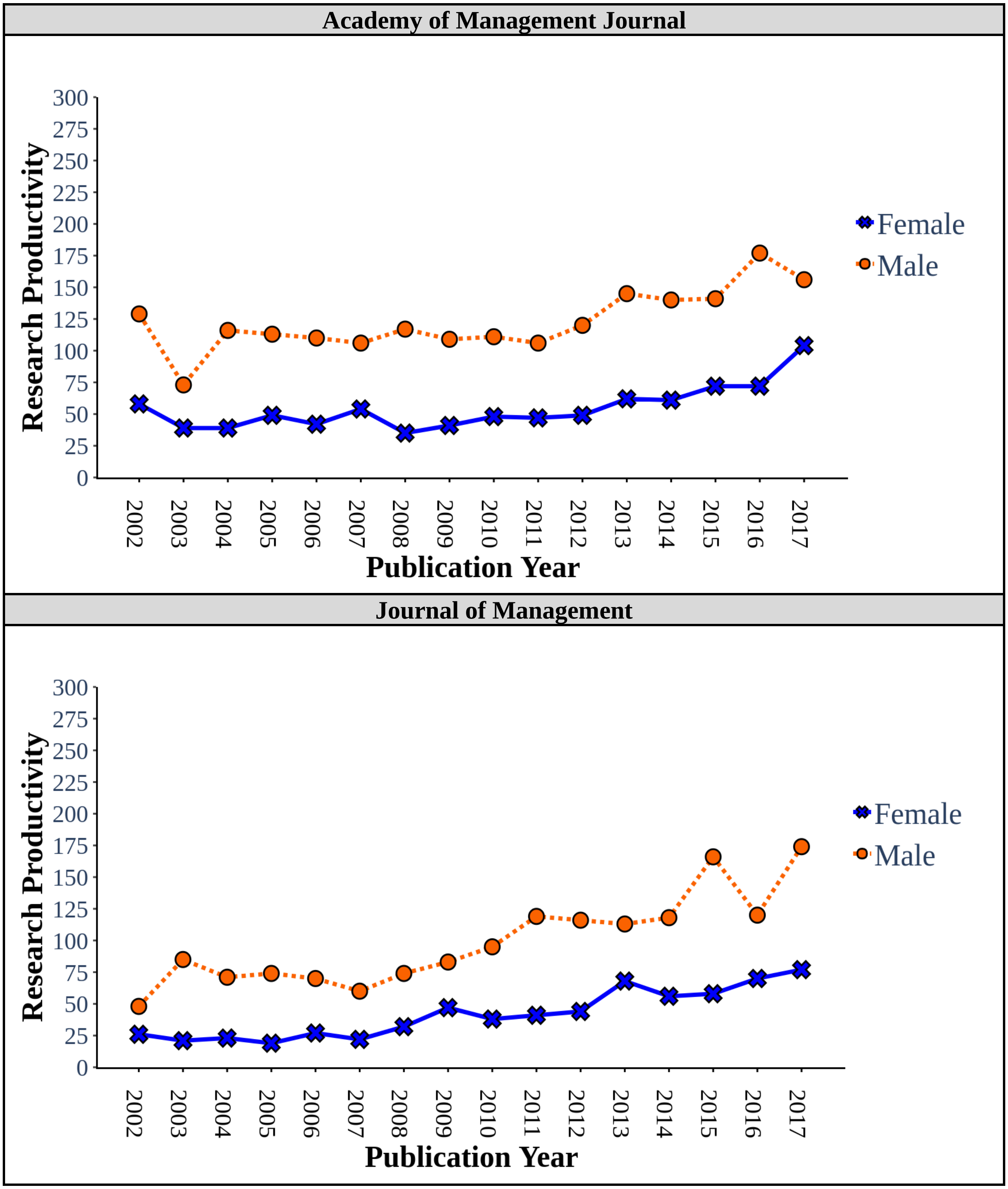

Figure 4. Charts depicting each gender's annual research productivity (i.e., authorship counts) in Academy of Management Journal and Journal of Management (2002 to 2017).