FACETS
a multidisciplinary open access science journal

COMMUNICATION

What a scientist looks like: Portraying gender in the scientific media

Becky Loverock[a] and Miranda M. Hart[a]*

[a]Department of Biology, University of British Columbia Okanagan, Kelowna, BC V1V 1V7, Canada

*miranda.hart@ubc.ca

Abstract

How men and women are portrayed in the media informs societal attitudes towards gender. Although this is true for all media, the scientific media has received little scrutiny, despite known gender biases inherent in scientific culture. We asked whether the top scientific journals, *Nature* and *Science*, represented men and women equally as authors, subjects, and objects in photographs. Overwhelmingly, women were underrepresented in these magazines, an effect that was apparent even in advertisements and stock photographs. Clearly, gender bias in science exists at many levels.

Key words: gender bias, media, science magazines, stereotypes, STEM

Introduction

Women's representation in science, technology, engineering, and medicine (STEM) has lagged despite an increase in the number of women graduating from these programs (Coleborn 2014). Described as a leaky pipeline (Goulden et al. 2009), the passage from receiving a PhD to attaining tenure is markedly harder for women. Women in science are paid less (Moss-Racusin et al. 2012) and are less likely to be cited (Larivière et al. 2013) or recommended for peer review (Lerback and Hanson 2015) compared with men. Despite a growing recognition of this disparity by society, and efforts towards affirmative action, this bias persists. Are women self-selecting out of the pipeline?

Social learning theory suggests that new patterns of behaviour can be acquired by observing the behaviour of others (Bandura 1971). Scientists are strongly influenced by scientific culture in their institutions and abroad. Media represents an important source of role models for scientists (Chimba and Kitzinger 2010). However, role models for women scientists in the media have been problematic, as women are either lacking (Miller et al. 2015) or portray traditionally "feminine" roles that emphasize motherhood or sexuality (Chimba and Kitzinger 2010). Media representations of women in science inform the nascent identity-building of young women—and this identity is central to their ultimate career choices (Mendick and Moreau 2013).

Elite journals such as *Science* and *Nature* carry significant weight in their ability to influence the scientific culture, including gender stereotypes. These journals feature a range of articles that reflect what scientists value, who they are, and even what they look like. These journals provide a weekly snapshot into scientific culture.

Citation: Loverock B and Hart MM. 2018. What a scientist looks like: Portraying gender in the scientific media. FACETS 3: 754–763. doi:10.1139/facets-2017-0110

Handling Editor: Imogen Coe

Received: September 18, 2017

Accepted: May 22, 2018

Published: July 16, 2018

Published by: Canadian Science Publishing

We were interested in what this snapshot looked like with respect to gender representation. Are influential journals perpetuating a biased image of the scientist? It has been suggested that the lack of women in STEM is partly attributed to the lack of female role models (Coleborn 2014). Science journals provide a model of the archetypal scientist—if that archetype is predominantly masculine, then the scientific culture itself may be contributing to gender disparity.

Here, we asked whether there was a gender bias in the representation of women and men within the pages of *Science* and *Nature*. We examined three months of journal issues and found unequal proportions of male and female representation in authorship, content, and visibility in photographs.

Methods

Data collection

We investigated three months of *Science* and *Nature* issues from 2016 ($n = 27$) (see supplementary materials and methods (**Supplementary Material 1**) for further information on issue selection). For each of the categories below, we recorded counts of people exhibiting predominantly male, female, or undetermined gender representation (**Tables S1** and **S2**).

Authorship

We noted the gender for corresponding authors of scientific literature and authors of general interest pieces. In *Nature*, the scientific literature included Reviews, Articles, and Letters. In *Science*, the equivalent paper types were Reports, Research Articles, and Perspectives. General interest pieces included all other articles written by staff scientists.

Subject

We considered the gender of subjects of "featured scientist" and "advertisement feature" articles. "Featured scientist" articles highlight an individual scientist for their achievements. "Advertisement features" are designed to look like journal content and typically feature the headshot of an individual with the written portion designed to look like an interview.

Photographs

We considered photographs that contained only one person, including "featured scientists", photographs used in advertisements, photographs used in advertisement features, and stock or anonymous photographs used to supplement general interest articles. We also analysed photographs depicting more than one person. Here, our intent was to determine the relative status of women versus men in photographs. See supplementary materials and methods (**Supplementary Material 1**) for more information on photograph assessment.

Data analysis

We used the equal or given proportions test (Wilson 1927) to test the null hypothesis that male and female representation is equal. Bonferroni correction was applied to raw p-values to account for multiple tests (see **Tables S3** and **S4** for raw and adjusted p-values). All analyses were performed using R Studio (Version 1.0.136) (R Core Team 2017).

Results

Authorship

Corresponding author

Authorship showed the highest incidence of gender bias (Fig. 1). In *Nature*, female scientists made up only 14% ($p < 0.001$) of corresponding authors in the scientific literature. Similarly, 15% of corresponding authors in *Science* ($p < 0.001$) were women.

General interest articles

There was no significant gender bias for general interest pieces in *Nature* (women authored 48% of articles), but a significant bias was observed in *Science*, where women wrote only 40% of general interest articles ($p < 0.05$) (Fig. 1).

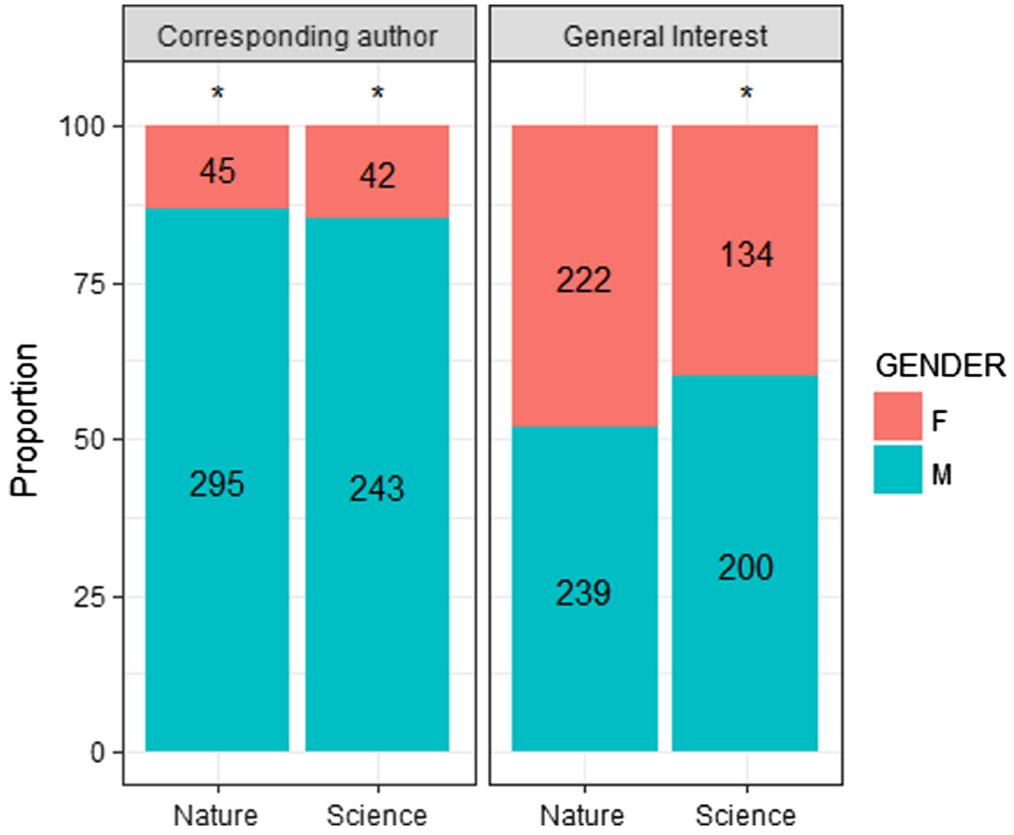

Fig. 1. Representation of women versus men in *Nature* and *Science* with respect to authorship. Scientific literature consisted of Nature Reviews, Articles, and Letters (*Nature*) and Science Reports, Research Articles, and Perspectives (*Science*). All other articles were classified as general interest articles. For more information on gender assignment, see supplementary materials and methods (Supplementary Material 1). Numeric values on the bars represent total count data across all journal issues examined. Statistical significance ($p < 0.05$) is denoted by an asterisk (*).

Subject

Featured scientist

Nature featured women scientists only 27% of the time ($p < 0.01$), similar to 33% in *Science* ($p > 0.05$) (Fig. 2).

Advertising feature

Nature used women as the subject in 18% of advertising features ($p < 0.01$). In *Science*, women were the subject of only 8% of advertising features ($p < 0.001$) (Fig. 2).

Photographs

Single person photographs

Featured scientist

Women were significantly underrepresented in photographs of featured scientists in *Nature* (19%, $p < 0.001$) but less so in *Science* (39%, $p > 0.05$) (Fig. 3).

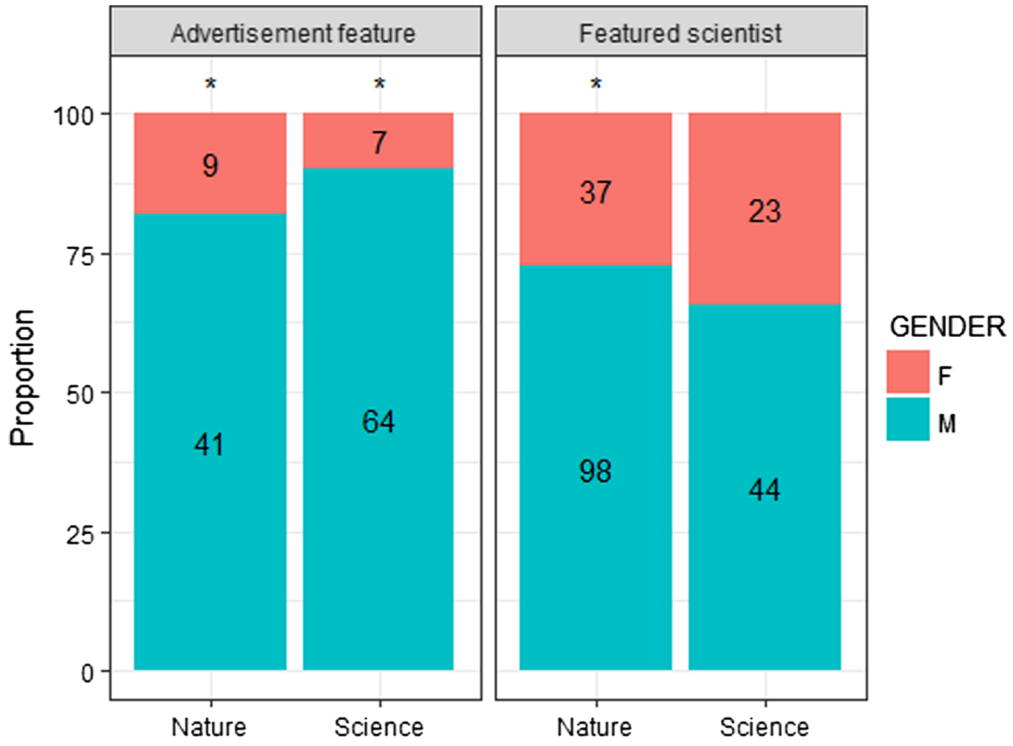

Fig. 2. Representation of women versus men in *Nature* and *Science* as the subject of general interest articles with respect to their exclusion from scientific literature sections (*Nature*: Reviews, Articles, and Letters; *Science*: Reports, Research Articles, and Perspectives). For more information on gender assignment, see supplementary materials and methods (Supplementary Material 1). Numeric values on the bars represent total count data across all journal issues examined. Statistical significance ($p < 0.05$) is denoted by an asterisk (*).

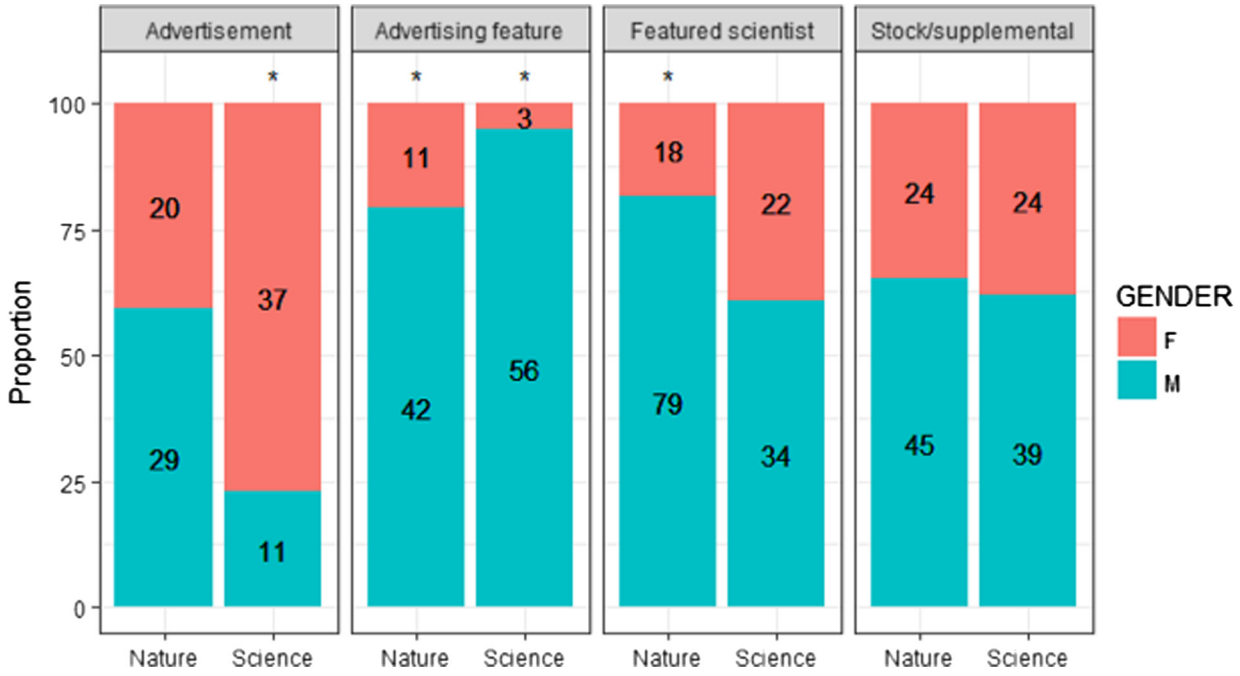

Fig. 3. Representation of women versus men in *Nature* and *Science* with respect to photographs depicting a single person. Photograph subcategories included advertisements, advertising features, featured scientists, and stock/supplemental photographs. For more information on gender assignment, see supplementary materials and methods (Supplementary Material 1). Numeric values on the bars represent total count data for that subcategory from each journal. Statistical significance ($p < 0.05$) is denoted by an asterisk (*).

Advertisement

Advertisements in *Nature* portrayed women in 41% of photographs ($p > 0.05$), but in *Science*, women were more often the subject of single person photographs (77%) ($p < 0.005$) (Fig. 3).

Advertising feature

Nature depicted women in 21% of advertising photographs, but this decreased to only 5% in *Science* ($p < 0.001$ both journals) (Fig. 3).

Stock photographs

Women were less often the subject of stock photographs in both journals (*Nature* 40%, Science 35%) ($p > 0.05$ in both journals) (Fig. 3).

Photographs depicting more than one person

Men represented the authority figure in 60% (versus 40% women) in *Nature* and 57% (vs. 43% women) of photographs in *Science*, but these differences were not statistically significant (see Tables S1–S4).

Discussion

Although *Science* and *Nature* routinely publish analyses and general interest articles about gender and STEM, our results suggest that the journals themselves may inadvertently perpetuate a biased image of what constitutes a scientist.

The bias is particularly dramatic for corresponding authors in the scientific literature. It is tempting to ascribe the lack of women as corresponding author to gender disparity among faculty members in the institutions themselves (Bain and Cummings 2000; Sheltzer and Smith 2014). Simply put, there are not as many women who could assume the role of principal investigator. However, although women are underrepresented among faculty members, their numbers in Canada are higher than what is portrayed in the journal. For example, in 2009, women comprised up to 30% of full time faculty in STEM at Canadian universities (Hango 2013). This is significantly more than primary authorship would suggest.

Whatever societal hurdles are preventing these women from publishing to the same extent as their male peers, the movement of women into senior academic roles is a slow transition (Surawicz 2016). It behooves journals to ensure equitable gender representation among authors because bias against female authors has been widely documented (Tregenza 2002). Innovative editorial workflows (such as double blind reviews (Budden et al. 2008)) may help improve the visibility of women authors.

The bias among authors of general interest articles is less extreme than primary authorship, which suggests that the journals are doing better at gender parity in the workforce. From the masthead listed on their website, the gender breakdown of editors and staff writers at *Nature* at the time of writing was approximately 42 women to 27 men. *Science* does not limit their masthead to writing staff, but also includes technicians, managers, and analysts. The gender ratio of the credited team members was 98 women to 79 men at the time of writing. The fact that more women are on staff at *Science* and fewer articles have female authors suggests that institutional barriers remain for women getting a piece to print.

Both journals featured significantly more male scientists than female as the subject of their general interest articles. This type of article is highly visible, spanning multiple pages and containing numerous photographs of the featured scientist. Whether or not this bias reflects a bias from the journal in selecting predominantly male candidates, or arises from reported modesty among women scientists, is unknown (Breithaupt 2001; Lerback and Hanson 2015). Whatever the root cause, an equal representation of men and women scientists in the media would help encourage more women to participate in STEM.

This bias was magnified for advertisement features, which featured male scientists almost exclusively in both journals. It is important to note that this is paid content. The intent of these advertisements is to blend in with journal content, and it is difficult for a typical reader to differentiate these ads from true articles (Crook 2004). Such strong bias may reflect the culture of the companies, and not the culture of science itself; yet, this matters little to the average reader. Ultimately, advertising decisions are an important part of the brand identity. Editorial boards have the ability to influence the nature of their advertisements and to demand content that does not alienate half of their readership.

Almost unilaterally, men were the subject of single person photographs in both journals. The only category where a bias was found in favour of women was in photographs associated with advertisements in *Science* (**Fig. 3**). The use of women in advertising is not surprising, as women models have historically been used to sell products to both women and men (Bower 2001). A recent study showed that when women were portrayed more often than men in the Spanish media they appeared as "decoration" (González et al. 2017). The preference for women models was not true for *Nature*. Whether this reflects a cultural divide among British and American cultural norms is not clear. Most of the photographs featuring women in science were some form of self-promotion, so it may be that *Science* is targeting a female demographic. The bias towards males in advertisement feature photographs reflects the bias in the subject of these articles. Evidence of this bias was more

obvious in some issues than others. Issues featuring a spotlight on Chinese researchers typically contained pages of male-dominated advertisement features, causing a dramatic shift in the proportional representation of gender in this subcategory.

The lack of female representation in *Nature* and *Science* presented here may have implications for the lack of parity in the STEM workforce. Not only are women scientists being heard less, they are also being seen less. A young woman flipping through a current issue may consciously or subconsciously affirm beliefs science is a male activity (Miller et al. 2015).

The presence of positive female role models can change this belief (Coleborn 2014). Female representation at conferences and in the workplace consistently leads to increased female participation in science (Murphy et al. 2007; Young et al. 2013; Miller et al. 2015; Sardelis and Drew 2016). Conversely, exposure to gender stereotypes decreases women's self-esteem (Sanchez and Crocker 2005) and job success (Reuben et al. 2014; Schuster and Martiny 2017), and can result in depression (Sanchez and Crocker 2005; Panayiotou and Papageorgiou 2007). As early as six, girls are less likely to believe that members of their own gender can be considered "really, really smart" when compared with the boys in their class and will even begin to avoid activities that they associate with intelligence (Bian et al. 2017, p. 389).

It is the responsibility of publishers to not only ensure that their publications do not promote outdated stereotypes, but they must actively promote equality among sexes within their pages. Many of the explicit biases limiting women's participation in STEM have been removed, yet parity remains elusive perhaps due to implicit biases among the women themselves (Ceci and Williams 2011). Changing implicit gender stereotypes changes requires "repeated and varied" exposure to counter stereotypes (Miller et al. 2015, p. 639). Journals have an important role in expediting this change—editorial content does not need to wait for the numbers to catch up. Equitable and authentic representation in the scientific media may be the simplest and quickest way to address the "leaky pipeline".

Acknowledgements

MMH was funded by NSERC (Discovery Grant).

Author contributions

MMH conceived and designed the study. BL performed the experiments/collected the data. BL and MMH analyzed and interpreted the data. MMH contributed resources. BL and MMH drafted or revised the manuscript.

Competing interests

The authors have declared that no competing interests exist.

Data accessibility statement

All relevant data are within the paper and in the Supplementary Material.

Supplementary Material

The following Supplementary Material is available with the article through the journal website at doi:10.1139/facets-2017-0110.

Supplementary Material 1

References

Bain O, and Cummings W. 2000. Academe's glass ceiling: societal, professional-organizational, and institutional barriers to the career advancement of academic women. The University of Chicago Press on behalf of the Comparative and International Education Society, 44: 493–514. DOI: 10.1086/447631

Bandura A. 1971. Social learning theory. General Learning Press, New York City, New York. 46 p.

Bian L, Leslie S-J, and Cimpian A. 2017. Gender stereotypes about intellectual ability emerge early and influence children's interests. Science, 355: 389–391. PMID: 28126816 DOI: 10.1126/science.aah6524

Bower AB. 2001. Highly attractive models in advertising and the women who loathe them: the implications of negative affect for spokesperson effectiveness. Journal of Advertising, 30(3): 51–63. DOI: 10.1080/00913367.2001.10673645

Breithaupt H. 2001. Losing them is not an option. As society cannot afford to lose them and the investment in their education, the question is, what to do about it? European Molecular Biology Reports, 2: 651–655. PMID: 11493589 DOI: 10.1093/embo-reports/kve167

Budden AE, Tregenza T, Aarssen LW, Koricheva L, Leimu R, and Lortie CJ. 2008. Double-blind review favours increased representation of female authors. Trends in Ecology & Evolution, 23: 4–6. PMID: 17963996 DOI: 10.1016/j.tree.2007.07.008

Ceci SJ, and Williams WM. 2011. Understanding current causes of women's underrepresentation in science. Proceedings of the National Academy of Sciences of the USA, 108: 3157–3162. PMID: 21300892 DOI: 10.1073/pnas.1014871108

Chimba M, and Kitzinger J. 2010. Bimbo or boffin? Women in science: an analysis of media representations and how female scientists negotiate cultural contradictions. Public Understanding of Science, 19: 609–624. PMID: 21553601 DOI: 10.1177/0963662508098580

Coleborn J. 2014. Mind the gender gap. Clinical Pharmacist, 6(8): 186. DOI: 10.1211/CP.2014.20066743

R Core Team. 2017. R: a language and environment for statistical computing. Available from r-project.org/.

Crook J. 2004. On covert communication in advertising. Journal of Pragmatics, 36: 715–738. DOI: 10.1016/S0378-2166(03)00039-0

González D, Mateau A, Pons E, and Domiguez M. 2017. Women scientists as decor: the image of scientists in Spanish press pictures. Science Communication, 39: 535–547. DOI: 10.1177/1075547017719074

Goulden M, Frasch K, and Mason MA. 2009. Patching America's leaky pipeline in the sciences. Berkley Center on Health, Economic & Family Security. Open file 2009–18. Berkeley Law, University of California Berkeley, Berkeley, California [online]: Available from americanprogress.org/issues/women/reports/2009/11/10/6979/staying-competitive/.

Hango D. 2013. Gender differences in science, technology, engineering, mathematics and computer science (STEM) programs at university. Insights on Canadian Society, Catalogue no. 75-006-X.

Statistics Canada, Ottawa, Ontario [online]: Available from 150.statcan.gc.ca/n1/pub/75-006-x/2013001/article/11874-eng.htm.

Larivière V, Ni C, Gingras Y, Cronin B, and Sugimoto CR. 2013. Bibliometrics: global gender disparities in science. Nature, 504: 211–213. DOI: 10.1038/504211a

Lerback J, and Hanson B. 2015. Journals invite too few women to referee. Nature, 541(7638): 455–457. PMID: 28128272 DOI: 10.1038/541455a

Mendick H, and Moreau MP. 2013. New media, old images: constructing online representations of women and men in science, engineering and technology. Gender and Education, 25: 325–339. DOI: 10.1080/09540253.2012.740447

Miller DI, Eagly AH, and Linn MC. 2015. Women's representation in science predicts national gender-science stereotypes: evidence from 66 nations. Journal of Educational Psychology, 107: 631–644. DOI: 10.1037/edu0000005

Moss-Racusin AC, Dovidio JF, Brescoll VL, Graham MJ, and Handelsman J. 2012. Science faculty's subtle gender biases favor male students. Proceedings of the National Academy of Sciences of the USA, 109: 16474–16479. PMID: 22988126 DOI: 10.1073/pnas.1211286109

Murphy MC, Steele CM, and Gross JJ. 2007. Signaling threat: how situational cues affect women in math, science, and engineering settings. Psychological Science, 18: 879–885. PMID: 17894605 DOI: 10.1111/j.1467-9280.2007.01995.x

Panayiotou G, and Papageorgiou M. 2007. Depressed mood: the role of negative thoughts, self-consciousness, and sex role stereotypes. International Journal of Psychology, 42: 289–296. DOI: 10.1080/00207590701318389

Reuben E, Sapienza P, and Zingales L. 2014. How stereotypes impair women's careers in science. Proceedings of the National Academy of Sciences of the USA, 111: 4403–4408. PMID: 24616490 DOI: 10.1073/pnas.1314788111

Sanchez DT, and Crocker J. 2005. How investment in gender ideals affects well-being: the role of external contingencies of self-worth. Psychology of Women Quarterly, 29: 63–77. DOI: 10.1111/j.1471-6402.2005.00169.x

Sardelis S, and Drew JA. 2016. Not "pulling up the ladder": Women who organize conference symposia provide greater opportunities for women to speak at conservation conferences. PLoS ONE, 11: e0160015. PMID: 27467580 DOI: 10.1371/journal.pone.0160015

Schuster C, and Martiny SE. 2017. Not feeling good in STEM: effects of stereotype activation and anticipated affect on women's career aspirations. Sex Roles, 76: 40–55. DOI: 10.1007/s11199-016-0665-3

Sheltzer JM, and Smith JC. 2014. Elite male faculty in the life sciences employ fewer women. Proceedings of the National Academy of Sciences of the USA, 111: 10107–10112. PMID: 24982167 DOI: 10.1073/pnas.1403334111

Surawicz CM. 2016. Women in leadership: why so few and what to do about it. Journal of the American College of Radiology, 13: 1433–1437. PMID: 28341310 DOI: 10.1016/j.jacr.2016.08.026

Tregenza T. 2002. Gender bias in the refereeing process? Trends in Ecology and Evolution, 17(8): 349–350. DOI: 10.1016/S0169-5347(02)02545-4

Wilson EB. 1927. Probable inference, the law of succession, and statistical inference. Journal of the American Statistical Association, 22: 209–212. DOI: 10.1080/01621459.1927.10502953

Young DM, Rudman LA, Buettner HM, and McLean MC. 2013. The influence of female role models on women's implicit science cognitions. Psychology of Women Quarterly, 37: 283–292. DOI: 10.1177/0361684313482109