Implicit bias:

Some relevant statistics and research

September 2016

# IEEE Award Statistics

The constitution of the IEEE membership was once very different than at present, with a much different concentration by gender, region, and technical field. Wherever we look, we find that IEEE awards have a considerably different distribution from the current IEEE membership. In part, this is due to a natural lag between the performance and recognition of outstanding contributions. Nevertheless, the differences appear to be more extreme than this explanation alone would suggest. One contributor to any such discrepancy could be implicit bias. Although we need to be concerned across all underrepresented demographics, statistics regarding women nominees and winners of IEEE awards are currently tracked. Thus, we use this as both an example and an important issue in its own right.

The percentage of women nominated for and that receive technical awards under the auspices of the IEEE (including paper awards, society awards, and IEEE awards) is considerably below their representation in the membership. Since IEEE awards were initiated, women have received a cumulative 19 Technical Field Awards (compared to 30 given annually, not including teaching awards which are counted separately here), a cumulative 9 Medals (compared to 16 given annually), and 3 Teaching Awards. Of the 29 different Technical Field Awards (TFAs) and 16 different medals, 21 TFA’s and 8 medals have never had a female recipient. The percentage of female medal and TFA recipients has increased somewhat in recent years: in 2014 there was one female medal recipient (no female TFA recipients); in 2015 there were two medal winners (including the first female recipient of the most prominent IEEE Medal, the Medal of Honor) and one female TFA recipient; and in both 2016 and 2017 there were two female TFA recipients (no medal recipients).

The frequency of nominations of women for TFAs and medals is another indicator. For some awards, there have been no nominations of women over a five-year timespan. Most recently (2011-2015), 4%-6% of the TFA nominations have been female, and 1%-7% of the medal nominations have been female. In 2015, two-thirds of all TFAs and half of all medals did not have a single female nominee. The percentage of medals and TFAs without a single female nominee were even higher in 2011-2014: with only 1-4 medals (out of 16) with a female nominee in that timeframe, and 5-8 TFAs (out of 29).

How do these percentages compare to the IEEE membership? The percentage of IEEE Fellow Grade members who are women is 4.4%, and that number is growing, with approximately 8% women among the Fellow elevations last year. Women currently constitute 12% of the total membership, although that is dominated by undergraduates; less than 9% of graduate student members, members, and senior members are women. Since medals are typically awarded towards the end of one’s career in recognition of cumulative accomplishments, and there are far fewer late-career women in the IEEE than women Fellows, the percentage of female medal winners each year is expected to be less than the percentage of female Fellows. However, it was 0% in both 2016 and 2017 which, coupled with the lack of nominations for a very large percentage of IEEE Medals each year, are troubling statistics. TFAs are typically awarded at an earlier career stage than medals. Indeed, TFAs are often a stepping stone to medal recognition. The percentage of women TFA winners in 2014-2017 ranges from 3.3% to 6.6%. Since TFAs are geared towards members somewhere between mid-career and late-career, it seems that a reasonable metric for the percentage of TFA recipients and nominees to be somewhere between the percentage of all IEEE female Fellows (4.4%) and the percentage of newly-elevated IEEE female Fellows (8%). In both 2014 and 2015, the percentage of TFA female recipients (3.3%) was less than the lower of these percentages, although the percentage in 2016 and 2017 (6.6%) is in this expected range.

The fact that a large majority of TFAs and medals have had no female nominees or recipients year after year is cause for concern that deserving women IEEE members are not receiving appropriate recognition for their work.

# Implicit bias in STEM fields

There is a substantial literature in implicit bias, most of it relating specifically to gender. (In the literature, this is sometimes called “unconscious” rather than “implicit” bias.) Many scientific studies have investigated implicit gender bias against women in Science, Technology, Engineering and Medical (STEM) fields. For example, a 2010 report by the American Association of University Women finds that environmental and social barriers — including stereotypes, gender bias (often implicit), and the climate of science and engineering departments in universities, continue to block women’s progress in science and engineering fields [1]. Interestingly, [1] also indicates that individuals who consciously reject negative stereotypes about women in science often still believe that science is better suited to men than women at an subconscious level. These subconscious beliefs or implicit biases may be more powerful than explicitly held beliefs and values simply because an individual cannot be aware of them. The White House Office of Science and Technology Policy has developed a concise summary on implicit bias including mechanisms to reduce its impact [2], and The Royal Society of Great Britain has developed an implicit bias briefing to introduce the key concepts and current academic research around implicit bias in order to alert Royal Society selection and appointment panel members to potential biases that can arise when making judgments or decisions [3]. A good repository of the most highly-cited reports on implicit bias towards women in STEM fields, including studies of undergraduates, graduate students, postdocs, faculty members, and people in industry, can be found in [4].

Implicit bias in STEM awards, honors, and recognition

Implicit gender bias with respect to research awards in science and math was specifically studied in [5]. That study found that, while women’s receipt of professional awards and prizes in these fields has increased in the past two decades, men continue to win a higher proportion of awards for scholarly research than expected based on their representation in the nomination pool. The results also indicate that implicit bias and committee chairs are the dominant contributing factors to this outcome. Other studies have shown that women undergraduates in biology are rated lower by their peers for academic performance relative to their male cohorts even when they are the better students and that, in fact, the top students in the class as perceived by their classmates are always male [6]; the ability to manage a science research lab based on equal credentials is lower for a (fictitious) woman versus a man [7]; a science conference abstract is rated lower for academic excellence when its (fictitious) author is female versus male [8]; science publications with dominant authors that are women versus men are cited less frequently [9], women are underrepresented in their invitations to write articles for prestigious science journals and to speak at prestigious science conferences [10][11], and that in recommendation letters for faculty candidates in chemistry with similar accomplishments, “recommenders used significantly more standout adjectives to describe male as compared to female candidates” [12]. All of these studies are in the fields of math and science where (except for physics) there are a much higher percentage of women than in electrical engineering and computer science [1]. Interestingly, it appears that men in university faculty positions as well as in the general public view research demonstrating gender bias against women in STEM as less meritorious than do women in these groups [13].

Since award nominations and recipients are based on perceptions of committee members and colleagues about research quality and candidate accomplishments, letters of recommendation, citations, and a person’s general standing in the field, these studies on gender bias certainly raise the possibility that such bias affects IEEE Award Committee nominations, deliberations, and outcomes. Such biases can relate not only to gender, but other dimensions like region and specialization as well.

# Annotated references

Here we have accumulated what we believe are the most relevant and compelling references, white papers, and repositories relating to implicit bias in the awards process.

[1] “Why So Few? Women in Science, Technology, Engineering, and Mathematics”, by the American Association of University Women (AAUW), <http://www.aauw.org/research/why-so-few/>

*This report presents in-depth profiles of eight key research findings that point to environmental and social barriers — including stereotypes, gender bias, and the climate of science and engineering departments in colleges and universities — that continue to block women’s progress in STEM. The executive summary states report that bias, often implicit, continues to limit women’s progress in scientific and engineering fields.*

[2] “Implicit Bias” by J. Handelsman and N. Sakraney. White House Office of Science and Technology Policy. <https://www.whitehouse.gov/sites/default/files/microsites/ostp/bias_9-14-15_final.pdf>

*This document concisely summarizes the key literature to date defining implicit bias and where it comes from, how to measure it, its impact, and how to reduce this impact. This is excellent reading on the subject.*

[3] “Unconscious bias”, adapted by Professor Uta Frith, Royal Society. <https://royalsociety.org/topics-policy/publications/2015/unconscious-bias/>

*A briefing by The Royal Society to introduce the key concepts and current academic research around unconscious bias in order to alert Royal Society selection and appointment panel members to potential biases that can arise when making judgments or decisions.*

[4] <http://www.aas.org/cswa/unconsciousbias.html>

*Large repository with the most highly-cited articles on implicit bias in STEM fields.*

[5] "The Matilda Effect in Science: Awards and Prizes in the US, 1990s and 2000s”, by A. Lincoln, S. Pincus, J. Koster, and P. Leboy, Social Studies of Science, April 2012

<https://raiseproject1.wordpress.com/2012/03/06/the-matilda-effect-in-science-awards-and-prizes-in-theus-1990s-and-2000s/>

*This study investigates gender bias in evaluations of research and analyzes data from 13 STEM disciplinary societies. While women’s receipt of professional awards and prizes has increased in the past two decades, men continue to win a higher proportion of awards for scholarly research than expected based on their representation in the nomination pool. The results support the powerful twin influences of implicit bias and committee chairs as contributing factors. In particular, the study looked at nominations and composition of award committees, where it found that women were statistically less likely win awards from panels headed by men, winning 5% of those awards, against 23% of prizes from panels headed by women. And men were much more likely to head prestigious research award panels.*

[6] “Science faculty’s subtle gender biases favor male students” by C. A. Moss-Racusina, J. F. Dovidio, V. L. Brescollc, M. J. Grahama, and J. Handelsmana, Proceedings of the National Academy of Sciences of the United States of America (PNAS)

<http://www.pnas.org/content/109/41/16474.full.pdf+htm>  
*In this study by Yale researchers, identical summaries of the accomplishments of two imaginary applicants for a lab manager position were presented to faculty physicists, chemists and biologists at six major research institutions. The applications were identical except for the gender-identifiable name of the applicant. The professors were significantly more willing to offer the man a job. If they did hire the woman, they set her salary, on average, nearly $4,000 lower than the man’s. Female faculty scientists demonstrated similar bias to their male counterparts.*

[7] “Males Under-Estimate Academic Performance of Their Female Peers in Undergraduate Biology Classrooms” by D. Z. Grunspan, S. L. Eddy, S. E. Brownell, B. L. Wiggins, A. J. Crowe, and S. M. Goodreau. PLOS One, February 2016.

<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0148405>

*Results in this study reveal that male undergraduate biology students are more likely than their female cohorts to be named by peers as being knowledgeable about the course content, even after controlling for class performance and outspokenness. The male students underestimated their female peers, over-nominating other men over better-performing women, with an overestimation of male grades by 0.57 points on a 4 point grade scale.These trends persist across eleven surveys taken in three different iterations of the same Biology course (a total of 1700 students). In every class, the most renowned students are always male.*

[8] “The Matilda Effect in Science Communication An Experiment on Gender Bias in Publication Quality Perceptions and Collaboration Interest” by S. Knobloch-Westerwick, C. J. Glynn, and M. Huge. Science Communication October 2013.

<http://scx.sagepub.com/content/35/5/603.full.pdf+html>  
*This study finds that graduate students in male-gender-typed science fields evaluate conference abstracts of fictitious authors more positively when the author has a male name versus a female name.*

[9] “Global gender disparities in science” by V. Larivière, C. Ni, Y. Gingras, B. Cronin, and C.R. Sugimoto, Bibliometrics:Nature 504(7479): 2013.

<http://doc.sciencenet.cn/upload/file/20131212152030894.pdf>

*This study examined 5,483,841 research papers and review articles with 27,329,915 authorships published between 2008 and 2012 and indexed in the Thomson Reuters Web of Science databases. The study found that all articles with women in dominant author positions receive fewer citations than those with men in the same positions.*

[10] “Gender matters: A call to commission more women writers” by D. Conley and J. Stadmark, Nature, August 2012.

<http://www.nature.com/nature/journal/v488/n7413/full/488590a.html>

*This study found that the proportion of women commissioned to write Nature News & Views articles was much lower than the proportion of women scientists overall: female authorship was 17.3% for the biological and chemical sciences, 8.1% for physical sciences and 3.8% for Earth and environmental sciences, with the pool of women scientists in these disciplines significantly higher than the proportion of female authorship at 32%, 16% and 20%, respectively.*

[11] “Fewer invited talks by women in evolutionary biology symposia” by J. Schroeder et al. Journal of Evolutionary Biology, 2013.

<http://onlinelibrary.wiley.com/doi/10.1111/jeb.12198/abstract>

*This study analyzed the gender of presenters at a large symposium on evolutionary biology. It found that women were significantly underrepresented among invited speaker compared to their percentages in the field.*

[12] “A Linguistic Comparison of Letters of Recommendation for Male and Female Chemistry and Biochemistry Job Applicants” by T. Schmader, J. Whitehead, and V. H. Wysocki, Pub Med Central, July 2016. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2572075/#R1>

*This study examined 886 letters of recommendation written on behalf of 235 male and 42 female applicants for either a chemistry or biochemistry faculty position at a large U.S. research university. Results revealed more similarities than differences in letters written for male and female candidates. However, recommenders used significantly more standout adjectives to describe male as compared to female candidates. Letters containing more standout words also included more ability words and fewer grindstone words.*

[13] “Quality of evidence revealing subtle gender biases in science is in the eye of the beholder” by I. M. Handleya, E. R. Browna, C. A. Moss-Racusinc, and J. L. Smitha, PNAS 2015.

<http://www.pnas.org/content/112/43/13201.full.pdf>

*This study examines receptiveness of scientific and public communities to empirical evidence documenting gender bias against women and their research—and favoring men—in STEM fields.  
Results from three experiments, using general-public and university faculty samples, demonstrated that men evaluate the quality of research unveiling this bias as less  
meritorious than women.*

[14] “Tools for Changing Gender Bias in STEM”. <http://www.toolsforchangeinstem.org/gender-bias-in-stem/>

*Tools developed by Tools for Change together with the Associated of Women in Science to raise awareness and train department chairs as well as individual faculty members on issues around unconscious bias in STEM fields.*

[15] “Tutorials for Change: Gender Schemas and Science Careers”, by V. Valian. ‘

<http://www.hunter.cuny.edu/gendertutorial/slides/gt04.htm>

*Tools developed by The Center for WorkLife Law at UC Hastings College of the Law to educate department chairs, search committees, and individuals on combating gender bias in STEM.*

[16] “The Matilda Effect in STEM: What You Can Do to Mitigate the Role of Bias in Awards” by H. Metcalf. <https://www.aamc.org/members/gwims/communications/431526/metcalfarticle.html>

*Report written by the Director of Research and Analysis, Association for Women in Science (AWIS) with specific recommendations to mitigate the impact of implicit bias in award committee deliberations.*