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J Neurophysiol 101:2195-2196, 2009. First published Mar 11, 2009; doi:10.1152/jn.00196.2009

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Is There Gender Bias in the Peer Review Process at *Journal of Neurophysiology*?

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There is no question that women remain underrepresented at senior levels in science (Committee on Maximizing the Potential of Women in Academic Science and Engineering 2006) and that science in general, and neuroscience specifically, will benefit by adopting policies to ensure inclusive, merit-based evaluation and advancement. To see this disparity in neuroscience we need look no further than the 2007 Survey of the Association of Neuroscience Departments and Programs, which found that women comprise 52% of the graduate student population but only 21% of Full Professors. Many explanations have been offered to explain this gender disparity including inflexible family leave policies, lack of appropriate mentoring for women, hostile work environments, and bias in the review process for research grants. It has also been suggested that gender bias in the peer review system for scientific publication is a factor. However, there have been few studies examining this issue empirically and those that have appeared have reached different conclusions (Budden et al. 2008a,b; Gilbert et al. 1994; Nylenna et al. 1994; Webb et al. 2008). With this in mind, we have set out to assess potential gender bias in the review process at *Journal of Neurophysiology* (*JN*).

To this end, we analyzed noninvited peer-reviewed manuscripts initially submitted to *JN* during the period January 1, 2007 to June 30, 2007. This interval was chosen so that every manuscript in the data set would have moved to a final decision, a process that often requires multiple rounds of review and revision; papers still in-process would not be able to provide a complete picture. The data set comprised 713 submissions. Of these, 7 were rejected by the Associate Editors without review and 12 were withdrawn by the authors following one or more rounds of review. At *JN*, Associate Editors make the final decisions in the review process; there is no mandatory consultation with the Chief Editor.

The data set consisted of the following entries for each manuscript: first author gender, last author gender, Associate Editor gender, referee gender (for each referee), first decision index, and final decision accept rate. Gender determination for authors and referees was confirmed by photographic web search. The small group of transgendered scientists known to us was scored according to their self-identified gender rather than their chromosomal sex. Of the 713 submissions, 13 were single-author papers and we scored those by entering the single author as both first and last.

During the period in which these manuscripts were evaluated, there were five designated decision types for the Associate Editor to choose: 1 = Accept, 2 = Review following minor revisions, 3 = Review following major revisions, 4 = Reject

with invitation to resubmit de novo, and 5 = Reject. More recently, decision 4, the “soft reject” has been eliminated as a formal decision type. The first decision score is simply the number corresponding to the Associate Editor’s decision. For the purpose of this analysis, the 12 withdrawn manuscripts were assigned a score of 5. We also calculated mean referee gender by assigning men a value of 0 (sorry, guys) and women a value of 1. Most manuscripts were evaluated by either 2 or 3 referees and the range was 1 to 4.

Here is an outline of our findings (see also Table 1). Of the 713 submissions in the data set, there were 191 submitted with women as first authors. These received a first decision score of 3.84 ± 0.05 (mean \pm SE) and a final accept rate of 43.4%. The 522 submissions with men as first authors received similar evaluations: a first decision score of 3.83 ± 0.05 and a final accept rate of 42.5%. Submissions with women as last authors numbered 120 and they received a first decision score of 3.87 ± 0.10 and a final accept rate of 42.5%, whereas the 593 submissions with men as last authors had a first decision score of 3.82 ± 0.04 and a final accept rate of 42.8%. Not much difference to speak of. What about combinations of first and last authors? The 59 submissions with women as both first and last authors fared the best, with an initial score of 3.77 ± 0.14 and a final accept rate of 49.1%, followed by the 460 submissions with men as both first and last authors, which received an initial score of 3.81 ± 0.05 and a final accept rate of 43.3%, and trailed further by the 194 mixed submissions (woman

TABLE 1. Submission outcomes as a function of author, associate editor (AE), and referee gender for manuscripts submitted in January–June 2007

First Author	Last Author	AE	Referee Mean	n	First Decision (Mean \pm SE)	Final Decision % Accept
M				522	3.83 ± 0.05	42.5
F				191	3.84 ± 0.05	43.4
	M			593	3.82 ± 0.04	42.8
	F			120	3.87 ± 0.10	42.5
M	M			460	3.81 ± 0.05	43.3
M/F	M/F			194	3.89 ± 0.08	39.7
F	F			59	3.77 ± 0.14	49.1
	M	M		242	3.76 ± 0.07	45.0
	M	F		351	3.87 ± 0.05	41.1
	F	M		51	3.78 ± 0.15	47.1
	F	F		69	3.91 ± 0.14	40.0
	M		<0.5	478	3.80 ± 0.05	44.3
	M		≥ 0.5	108	3.89 ± 0.10	43.3
	F		<0.5	98	3.84 ± 0.05	43.9
	F		≥ 0.5	21	3.95 ± 0.23	40.9

During the period in which these manuscripts were evaluated, there were five designated decision types for the Associate Editor to choose from: 1 = Accept, 2 = Review following minor revisions; 3 = Review following major revisions; 4 = Reject with invitation to resubmit de novo; and 5 = Reject. Mean referee gender was calculated by assigning men a value of 0 and women a value of 1.

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first/man last and vice versa), which received an initial score of 3.89 ± 0.08 and a final accept rate of 39.7%.

We have also broken down these outcomes by Associate Editor gender. Of those submissions with a woman as last author, those handled by a woman as Associate Editor had a final accept rate of 40.0%, whereas those handled by a man as Associate Editor had a final accept rate of 47.1%. Submissions from men as last authors handled by a woman as Associate Editor were accepted at a rate of 41.1%, whereas those handled by a man as Associate Editors were accepted at a rate of 45.0%. So, in our sample, the women Associate Editors accepted papers from both men and women as last authors at slightly lower rates. It is not possible to know what underlies this difference. However, in interpreting these findings it is worthwhile to note that manuscripts are not randomly distributed to Associate Editors. The manuscripts are assigned by area and it has been our experience that the various areas of neurophysiology do not produce manuscripts of equal mean quality or level of general interest.

To assess outcomes based on referee gender, we calculated a referee gender mean and then split manuscripts into two groups, those with a mean of ≥ 0.5 ($\geq 50\%$ women as referees) and those < 0.5 . Submissions with men as last authors were accepted at a rate of 44.3% when the referee mean was < 0.5 and at a rate of 43.3% when the referee mean was ≥ 0.5 . Submissions from women as last authors were accepted at a rate of 40.9% when the referee mean was ≥ 0.5 and at a rate of 43.9% when the referee mean was < 0.5 . Thus it appears that, in our sample, on average, women last authors did not benefit from having women as referees in terms of the final accept rate.

The good news is that these data do not indicate substantial or overt gender bias in the peer review process at *Journal of Neurophysiology* in the recent past. Kudos to our referees and Associate Editors in this regard. One should be hesitant,

however, to apply these findings to other journals and other disciplines. Note that *Journal of Neurophysiology* had a panel in which 5 of 9 Associate Editors (and the Chief Editor) were women during the period of this analysis (it is now 5 of 11 Associate Editors). It is also worth highlighting that only 120 of 713 submissions (17%) were from women last authors, indicating that there's still a very long way to go to achieve the larger goal of gender equity in neurophysiology.

There are many possible ways to parse and analyze this data set. You may download it in either Excel spreadsheet or tab-delimited text form to perform your own analysis using the "Supplementary Data" link on-line. Furthermore, you are encouraged to comment on this editorial or post your own analysis of the data (statistical analyses, which we have avoided, are welcome) in a moderated forum using the "Submit a Response" feature on the on-line article page.

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