

# Gender bias in the refereeing process?

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**Scientists are measured by their publications. Yet anonymous peer review is far from transparent. Does bias lurk within the refereeing process? Investigating the outcomes of manuscript submissions suggests that the overall process is not sexist, but differences in acceptance rates across journals according to gender of the first author give grounds for caution. Manuscripts with more authors and by native English speakers are more successful; whether this is due to bias remains to be seen.**

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Senior academics in the field of ecology and evolution are predominantly male, in spite of a gender ratio that is closer to parity among younger researchers. Clearly, this pattern is the result of a combination of factors, but a pressing question is whether gender bias is involved. Studies of grant awards [1], promotions [2] and resource allocation [3] illustrate the potential for sexual discrimination in the allocation of funding. Potentially equally important, but less scrutinized, is the process by which decisions on the publication of manuscripts are made by referees and journal editors. With the help of the editorial staff of several high impact (ISI impact factor >2) ecology and evolution primary research journals, I have examined differences in acceptance rate according to gender, nationality and the number of authors on a manuscript.

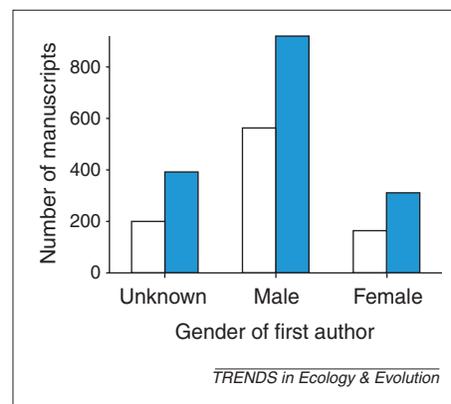
## The study

I wrote to the editors of 24 primary research journals requesting that they record the gender, nationality, number of authors and

### Box 1. Citation rates relative to gender, number of authors and country of affiliation

In November 2001, I examined the citation rate of 507 papers published 3–4 years previously in five leading ecology and evolution journals that generally publish authors' first names, allowing gender to be determined in most cases. Female authors do not appear more likely to use initials rather than their names: of papers where authors used initials, web searches and correspondence with co-authors revealed that 12 out of 38 were female (2 way  $\chi^2 = 2.78$ ,  $P = 0.1$ ). The number of citations for each paper was determined from the ISI citation index. There were no differences in citation rate according to gender, (Kruskal Wallis;  $\chi^2 = 3.02$ ,  $P = 0.22$ ) as would be expected if the reviewing process and citation are unbiased in relation to gender. However, there were differences in citation rate between papers according to the number of authors, with two author papers most cited and a linear decline in citation rate through 3, 1 and 4+ authors (Kruskal Wallis;  $\chi^2 = 8.26$ ,  $P = 0.041$ ). Hence, although submissions with more than four authors are the most likely to be accepted, they are the least likely to be cited. Country of affiliation of the first author has a strong effect on number of citations, even if only wealthy countries are used (see main text), with papers from non-native English speaking countries attracting fewer citations (Kruskal Wallis;  $\chi^2 = 9.17$ ,  $P = 0.002$ ).

the final decision made on their submitted manuscripts over a period of a year. Seven editors from five journals agreed to take part providing data from 2680 manuscripts on the number of authors, the gender of the first author, their country affiliation, and whether the manuscript was finally accepted or rejected. Gender was



**Fig. 1.** Acceptance of manuscripts according to gender of first author. There is no overall difference in the acceptance rate of manuscripts according to whether the first author is designated as male, female or unknown. (Open bars, accepted manuscripts; blue bars, rejected manuscripts).

designated as unknown where it was not immediately apparent from the author's first name (predominantly when only initials were provided) even if the editor actually knew the person's gender. There does not appear to be any gender difference in likelihood of choosing to use initials rather than first names (Box 1). Data were collected within the period 1997 to 2000.

Of 2680 manuscripts, 1558 had male first authors, 498 female, and 624 unknown gender, ( $\chi^2 = 751$ ,  $P < 0.001$ ). There was no difference in the proportion of manuscripts each gender submitted as a sole author (excluding unknown gender manuscripts) ( $n = 2056$ ,  $\chi^2 = 2.45$ ,  $P = 0.12$ ).

## Effect of author gender

Combining data from all journals ( $n = 2550$  excluding those pending a decision), there is no overall difference in the acceptance rates of papers according to gender ( $\chi^2 = 4.04$ ,  $P = 0.13$ ) (Fig. 1). This pattern is the same if only single author papers are considered ( $n = 554$ ,  $\chi^2 = 1.97$ ,  $P = 0.37$ ).

Had there been a difference in acceptance rate relative to gender it would

**Table 1. Chi-Square tests of the numbers of papers submitted by authors of a particular gender according to whether they are accepted for publication.**

Journal/Editor by descending acceptance rate	% Manuscripts by each gender that are accepted				$\chi^2$	<i>P</i>	<i>n</i>
	Unknown	Male	Female				
1	39	46	53	3.79	0.15	352	
2	34	46	27	3.74	0.15	178	
3	30	45	25	2.46	0.29	77	
4	20	40	32	2.42	0.30	246	
5	50	36	43	0.56	0.76	70	
6	38	36	36	0.25	0.88	928	
7	21	35	23	11.27	0.004	699	

be difficult to determine whether this was due to bias in the review process or differences in the quality of papers submitted by authors of different genders. However, one prediction that can be made is that there ought to be a consistent pattern of manuscript acceptance or rejection relative to gender across journals in the same field. I have examined the pattern of acceptance and rejection relative to author gender in each journal separately. Table 1 shows that acceptance rates do not differ relative to gender except in editor 7, where manuscripts by men have significantly higher frequency of publication than those in the other gender groups. This result remains significant at the 0.05 level after Bonferroni adjustment, but is not significant if the unknown gender class is ignored.

These data can be analysed using a loglinear modelling approach starting with a model with the factors: editor (1–7); author gender (male, female, unknown) and result (accept, reject). This analysis fails to reject the null hypothesis that there is no significant interaction between

journal and author gender in their effect on whether manuscripts are accepted for publication (Likelihood ratio  $\chi^2 = 18.39$ ,  $P = 0.104$ ). Hence, although the analysis in Table 1 suggests there are differences among journals in success of authors of different gender, this is not borne out by a more rigorous and conservative approach.

#### Effect of number of authors

There is a strong effect of number of authors on acceptance rates (using author categories 1,2,3 and >4,  $\chi^2 = 13.5$ ,  $P = 0.004$ ). Single authors are most likely to have their submissions rejected and manuscripts with more than four authors are more likely to be accepted (Fig. 2). This could reflect differences in quality of submitted manuscripts, or may be due to other factors such as an increased chance of a relationship with potential referees where there are more authors. Interestingly, the pattern of citation rates relative to author number (Box 1) is almost the opposite of the pattern of acceptance rates.

#### Effect of country of affiliation of first author

Manuscripts were submitted from 62 different countries. Countries were classified as high or low income, as defined by the World Bank [4], their criteria being a GDP of >US\$9625 per person, and according to whether English is a national language. I have used three mutually exclusive categories: 1 = high income, native English speaking; 2 = high income, non-native English speaking; and 3 = low income, (76% of manuscripts from which were non-English speaking). There is a strong effect of country of affiliation on manuscript acceptance ( $\chi^2 = 35.0$ , d.f. = 2,  $P < 0.001$ ). If only wealthy nations are included, there remains a strong difference, with 41% of papers from English speaking nations (Australia,

Canada, NZ, UK and USA) being accepted compared to only 33% from non-English speaking nations (EU countries, Israel, Japan, Norway and Switzerland) ( $\chi^2 = 14.6$ , d.f. = 1,  $P < 0.001$ ).

#### Discussion

This study suggests that the reviewing process for manuscripts is not 'institutionally sexist': there are no overall differences in manuscript acceptance or citation rate relative to gender. However, differences among journals in the acceptance rate of papers relative to gender gives grounds for caution because this pattern is difficult to explain without invoking bias. Additionally, most editors approached refused to take part, creating the possibility that the seven out of 24 editors that did agree to being studied are unusually aware of the potential for bias. Patterns of acceptance relative to the country of author affiliation are intriguing and might indicate that non-English speaking nations are at a disadvantage either as a result of discrimination or perhaps because of the additional burden of having to write in a foreign language. Previous studies have indicated that reviewers might favour manuscripts from their compatriots [5], and that reviewer gender has an effect on acceptance rates relative to author gender [6]. The present study suggests that the field of ecology and evolution might not be immune from such issues.

#### Acknowledgements

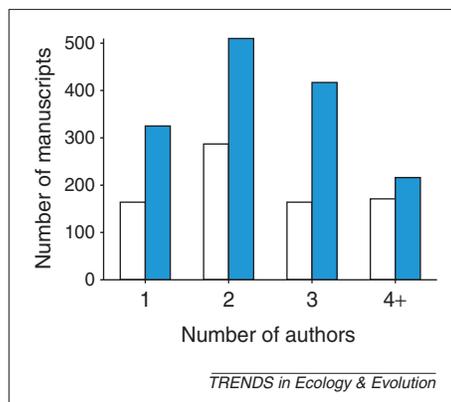
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**Fig. 2.** Frequency of acceptance (open bars) and rejection (blue bars) of manuscripts relative to the number of authors. There is a significant correlation between number of authors and likelihood of acceptance, with those with >4 authors more likely to be accepted than those with a single author.