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Title:

Gender imbalances in the editorial activities of a selective journal run by academic editors

Short title: Gender imbalance in the editorial activities

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1 ABSTRACT

2 The fairness of decisions made at various stages of the publication process is an important
3 topic in meta-research. Here, based on an analysis of data on the gender of authors, editors
4 and reviewers for 23,876 initial submissions and 7,192 full submissions to the journal eLife, we
5 report on five stages of the publication process. We find that the board of reviewing editors
6 (BRE) is men-dominant (69%) and that authors disproportionately suggest male editors when
7 making an initial submission. We do not find evidence for gender bias when Senior Editors
8 consult Reviewing Editors about initial submissions, but women Reviewing Editors are less
9 engaged in discussions about these submissions than expected by their proportion. We find
10 evidence of gender homophily when Senior Editors assign full submissions to Reviewing Editors
11 (i.e., men are more likely to assign full submissions to other men (77% compared to the base
12 assignment rate to men RE of 70%), and likewise for women (41% compared to women RE
13 base assignment rate of 30%)). This tendency was stronger in more gender-balanced scientific
14 disciplines. However, we do not find evidence for gender bias when authors appeal decisions
15 made by editors to reject submissions. Together, our findings confirm that gender disparities
16 exist along the editorial process and suggest that merely increasing the proportion of women
17 might not be sufficient to eliminate this bias. Measures accounting for women's circumstances
18 and needs (e.g., delaying discussions until all RE are engaged) and raising editorial awareness
19 to women's needs may be essential to increasing gender equity and enhancing academic
20 publication.

21

22

23 Introduction

24 Women remain underrepresented in science, technology, engineering, mathematics and
25 medicine (STEMM), and are also prone to experiencing bias and discrimination [1–5]. This
26 gender gap in representation and career advancement is present across all career stages [1,6–
27 9]. For example, beyond the clear disproportionate representation of men over women in
28 senior investigator categories, women receive fewer and less prestigious awards [10–14],
29 obtain fewer grants [15–17], are less frequently invited to write review or comment papers
30 [18–21], and have lower salaries relative to men [6,7,22]. Gender disparities at senior levels
31 are also noticeable for services to the broader scholarly community, where men are more likely
32 to provide higher status external service, whereas women tend to perform lower status
33 internal service [11,23]. Moreover, although women and men spend comparable time at work,
34 differences in how they fulfil their various responsibilities outside research (e.g., teaching and
35 service compared with research) [24,25] may contribute to differences in productivity and
36 ultimately to other markers of career success [2,8,26,27]. Due to these and other factors,
37 women benefit from less prominence and eminence at senior levels, relative to men
38 [2,5,11,28]. These disparities can arise from structural, institutional, and systemic sexism as
39 well as pervasive bias (whether implicit or explicit) harboured by colleagues of any gender [29–
40 31], and can have multiple adverse implications (e.g., for women’s pay [6,7,22] and promotion
41 [1,2,6–8,22]).

42

43 Scientific publishing is a central aspect of academia, with critical implications for hiring
44 decisions and career advancement. Inequalities, based on an author’s gender, have been
45 systematically documented along different stages of the scientific publishing process [4,20,32–

34]. First, the proportion of women as first and senior authors in peer-reviewed publications is lower than expected given their prevalence in the field [4,20,35–43]. Moreover, across different fields, women tend to submit fewer papers than men [43–45], with larger imbalances in journals with higher impact factors [46]. A higher publication standard for women authors, which in turn leads to decreased productivity, could contribute to this gap [47], as well as a smaller likelihood for attribution of credit in authorship for women than for men researchers [32,33]. Gender inequities are also evident once women cross the submission hurdle, in the evaluation of women-led manuscripts [41,47–49] [Though see 50 for opposite results]. For example, in several studies manipulating authors' identity, reviewers evaluated conference abstracts, papers, and fellowship applications supposedly written by men as better than when they were supposedly written by women [51,52]. Moreover, a recent analysis of peer review outcomes of 23,876 initial submissions and 7,192 full submissions that were submitted to the journal eLife showed a homophily effect between reviewers and authors [53]. In particular, the acceptance rate for manuscripts with men senior authors was greater than for women senior authors and this disparity was greatest when the team of reviewers only comprised men [53]. After publication, women are less cited than expected [54–63, though see 64 for opposite results]. This imbalance is mainly due to a homophily effect in men authors, wherein men under-cite women's publications compared to men's publications [54,65].

64

Gender disparities in the scientific publishing process may be further exacerbated by the underrepresentation of women among journal reviewers and editors. Editorial service is an essential element of the scientific enterprise. Editors and editorial boards are tasked with establishing benchmarks for scientific publishing and do so by engaging with a wide network of authors, reviewers, and other members of editorial boards. Insofar as editorial service has

70 the potential to influence the progress and direction of a given scientific field, appointment to
71 an editorial board reflects the high regard and trust of a community towards individual editors
72 [5,11,28]. Despite repeated calls for making deliberate effort to incorporate gender diversity
73 into editorial board structures [5,66], gender disproportions remain pervasive [67–73].
74 Presently, little is known about gender disparities in the editorial process itself. Here we
75 address this knowledge gap by examining whether the involvement of individuals in an editorial
76 board and along the different stages of the editorial process is subject to gender disparities.

77

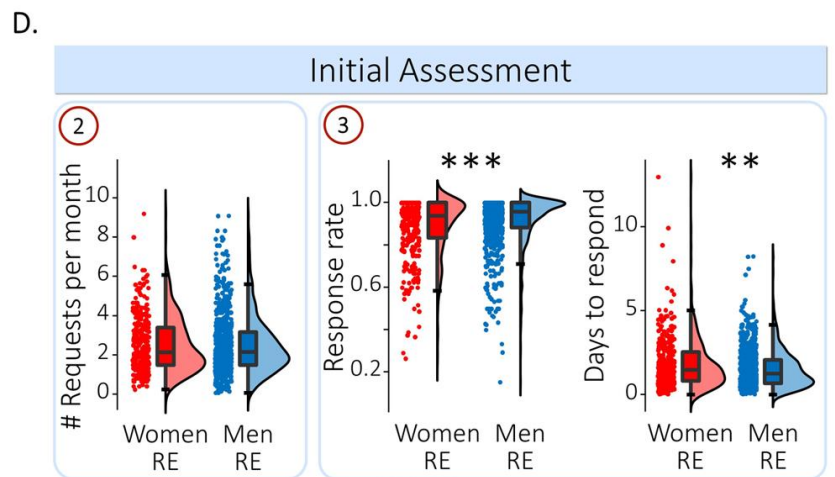
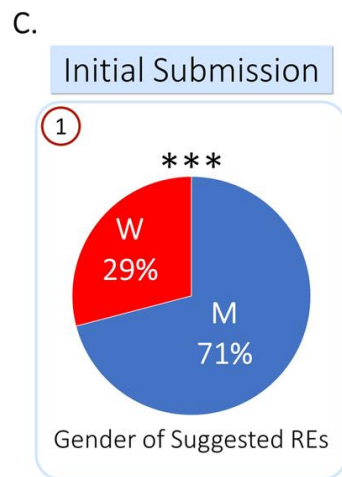
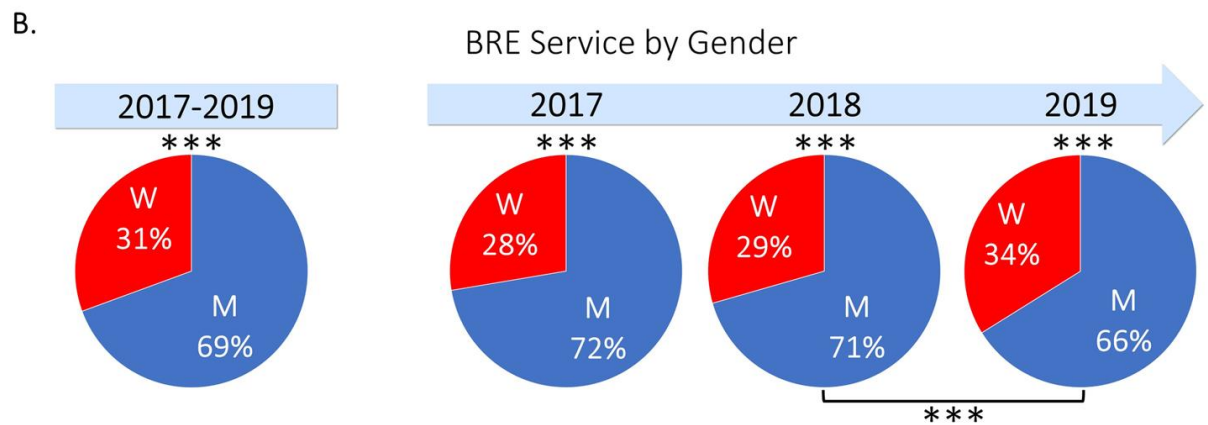
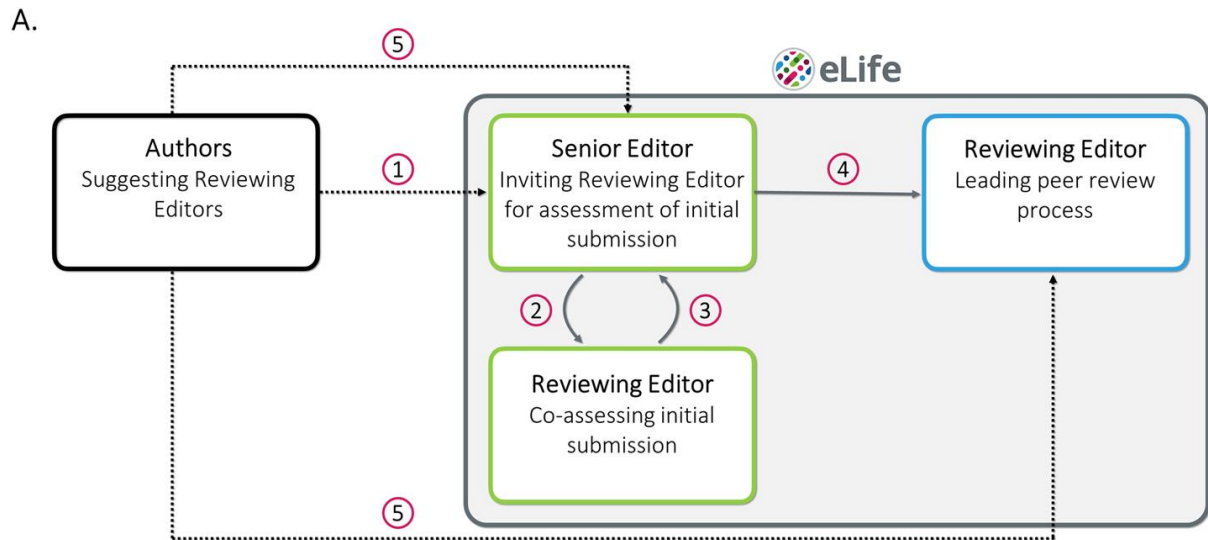
78 We focused on the journal eLife, a non-profit open-access journal led by researchers, that aims
79 to accelerate discovery by operating a platform for research communication that encourages
80 and recognises the most responsible behaviours (<https://elifesciences.org/about>). eLife
81 publishes selected research in all areas of biology and medicine, and its Editorial Board is
82 structured to contain broad expertise required to evaluate research quality. eLife employs over
83 600 researchers in their Board of Reviewing Editors (BRE) and from 2019 onwards in particular
84 have considered gender when recruiting new editors towards the goal of gender equality.
85 eLife’s review process broadly involves two main stages: initial evaluation of submissions by
86 the eLife editorial team, and evaluation of full submissions together with external reviewers
87 (see Figure 1A). While the initial evaluation of submissions involves an internal consultation
88 among eLife editors, the ensuing step of handling the review of full submissions includes
89 community-facing interactions with external experts. eLife has been collecting meta data on
90 all editorial interactions along this two-stage process, allowing to analyse not only women
91 editors’ representation in the editorial board, but also their active participation along the
92 different stages, thus teasing apart potential versus actual engagement of women. For these

93 reasons, eLife provides a rich case example to evaluate gender imbalance along key decision-
94 making processes in STEMM and in particular in STEMM journals' editorial process.

95

96 The aim of this study was to determine whether the involvement of individuals in eLife's BRE
97 is subject to gender disparities at various stages of the editorial process. Specifically, we sought
98 to determine whether women eLife editors are proportionally involved in the editorial decision
99 process compared to their representation in the BRE. To address this question, we explored
100 fully anonymous analytics collected by eLife's editorial platform. This data was collected for
101 monitoring purposes with the explicit aim to help improve eLife's submission and review
102 process. The analytics provided binary gender information ("man" or "woman" as assigned by
103 the editorial office based on scientists' names and perceived gender expression) relating to the
104 handling of submissions. We assessed the presence of gender imbalance at different stages of
105 editors' participation, starting with the external influence of authors who are invited to
106 nominate potential editors (and appeal their decisions), through to the engagement of
107 Reviewing Editors (REs) by Senior Editors, and then ending with the responsiveness of REs to
108 editorial assignments. Based on the literature reviewed above [e.g. , 53,54,67,73], we predicted
109 that despite efforts to increase the involvement of women in the BRE, women's editorial
110 activities would be lower in comparison to men, even after taking into consideration their
111 proportional disparity in the editorial system. Based on related research [53,54,67], we further
112 predicted that decreased engagement would be exacerbated by a homophily effect, where
113 men Senior Editors are more likely to engage men REs. By elucidating the editorial actions
114 where gender imbalance is more prominent, we hope that this study will motivate the scientific
115 community to work towards greater equity in this important process.

116



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Figure 1: Gender disparities in eLife's reviewing process. A. A schematic of the locations along eLife's reviewing process wherein imbalanced actions could potentially occur (left to right): Initial Submission (Action 1) – Authors

120 submit their manuscript and suggest potential members of the Board Reviewing Editors (BRE). Within eLife (grey
121 square), a Senior Editor invites BRE members for initial consultation (Action 2) and the Reviewing Editor (RE) gives
122 their opinion (Action 3). This stage of the editorial process is internal (green squares). Full Submission – If the
123 manuscript is retained, the Senior Editor assigns a RE to lead the reviewing process (Action 4). This community-
124 facing stage (blue square) includes overseeing reviewer selection and coordinating an open discussion between
125 the reviewers, the handling Senior Editor and the RE once all individual reviewer reports have been submitted.
126 Appeals – In the event of a rejection, Authors can appeal the initial assessment or the Full Submission decision
127 (Action 5). **B.** Proportion of BRE service of women and men REs in the entire study period (2017-2019; left) and
128 per study year (right). The gender disparity in BRE service is significantly imbalanced, as indicated by the asterisks.
129 **C.** Gender imbalance in Initial Submission: Authors suggest more men REs than the men base rate when first
130 submitting a manuscript (Action 1). **D.** Gender differences in Initial Assessment: Senior Editors equally engage
131 women and men REs in the initial consultation (Action 2). Women REs respond slightly less to Senior Editor’s initial
132 consultation requests (Action 3), and they take longer to respond than men REs. **E.** Appeal rates (Action 5) in the
133 Initial Assessment (Senior Editors only) and Final Decision (Senior and Reviewing Editors) do not depend on the
134 gender of the handling BRE. W=women (red); M=men (blue); SE=Senior Editor; RE=Reviewing Editor; Dashed
135 arrows – Actions external to eLife, Full grey arrows – Actions within eLife; * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

136 Results

137 Gender imbalance of eLife Reviewing Editors

138 We first quantified the gender ratio among eLife BRE members (Figure 1B). The proportion of
139 RE service contributed by men was significantly larger than the proportion contributed by
140 women throughout the entire study period (2017-2019: $N=12,518$ months, women vs. men
141 BRE service: 30.60% vs 69.40%; binomial $p < 0.001$; Cohen’s $h=0.40$; see supplementary data
142 and Sup Figure 1A for a comparison of months of service across gender).

143

144 We next considered dynamics in gender balance over the three-year window. The gender
145 imbalance observed overall slightly diminished over time due to eLife’s effort to recruit more
146 women to the BRE. The proportion of women in the BRE did not significantly differ between
147 2017 and 2018 (1.81% difference, $\chi^2_{(1)}=3.10$, $p=0.078$, Cohen’s $h=0.86$). By contrast, the
148 proportion in 2019 was significantly greater than that in 2018 ($N-1$ χ^2 proportion comparison
149 test; 2018 vs. 2019: 4.42% difference, $\chi^2_{(1)}=19.67$, $p < 0.001$, Cohen’s $h=0.78$). Despite this slight
150 improvement, the BRE gender base rate remained strongly imbalanced (2017: $N=3,715$
151 months, women vs. men BRE service months: 27.64% vs. 72.36%; 2018: $N=4,047$ months,

152 29.45% vs. 70.55%; 2019: $N=4,756$ months, 33.87% vs. 66.13%; binomial p -values <0.001 ; 2017:
153 Cohen's $h=0.46$, 2018: Cohen's $h=0.42$, 2019: Cohen's $h=0.33$). Accordingly, and for all
154 subsequent analyses, the 2017-2019 data were pooled to increase statistical power. Taken
155 together, these results indicate that there exists a pronounced gender imbalance in the BRE
156 gender base rate.

157 In the next analyses, we used the gender ratio of women BRE members as the base rate to
158 measure if women RE engagement was proportional to what was expected by their
159 representation in the BRE.

160

161 External influence in the Initial Submission – (Action 1)

162 At the Initial Submission stage, authors suggest potential BRE members that could handle their
163 manuscript (Action 1). We tested if this action was (im)balanced according to gender by
164 comparing the proportion of women REs that were suggested by authors relative to the
165 women BRE member base rate. A $N-1$ χ^2 proportion comparison test revealed that authors
166 suggest significantly fewer women REs than the corresponding proportion among eLife's BRE
167 (29.08% vs. 30.6%, $\chi^2(1)=11.65$, $p<0.001$, Cohen's $h=0.90$; Figure 1C). We next sought to
168 determine whether women's perceived expertise might be a partial explanation for authors'
169 imbalanced RE suggestions. Specifically, previous research points at potential disparity with the
170 broadness of term women and men use when communicating research [74]. Accordingly, we
171 tested whether women and men REs differed in the number of keywords used to showcase
172 their expertise. We found that women and men REs did not differ in their numbers of
173 associated keywords (Women: 5.51 ± 2.19 ; Men: 5.32 ± 2.39 ; $t_{(581)}=0.932$, $p=0.352$). We next
174 sought to determine whether a difference in the scope and reach of the keywords associated
175 with women and men REs could contribute to authors' imbalanced RE suggestions.

176 Accordingly, we quantified the number of PubMed search results for women and men BRE
177 members' keywords. Specifically, we queried the number of PubMed publications associated
178 with the string of keywords provided by each RE, using an 'OR' operator. This provided us with
179 a simple mean of scope. A permutation Welch's *t*-test comparing groups in the number of
180 PubMed search results was not significant (women vs. men search results:
181 1,755,724±2,979,049 vs. 1,920,643±3,307,501; $t(488.9475)=0.62$; $p=0.56$; Hedge's $g=-0.052$).
182 These data provide no evidence of a gender difference in the overall reach of the keywords
183 provided by BRE members.

184 [Internal processes in the Initial Assessment stage \(Actions 2-3\)](#)

185 We next explored the presence of gender imbalances during Initial Assessments. In this action,
186 the Senior Editor invites one or more REs for an initial consultation in order to assess whether
187 to invite a full submission of the manuscript for peer review. To test whether Senior Editors
188 tend to similarly engage women and men REs (Action 2), we compared the average number of
189 consultation requests per month for individual REs. A permutation Welch's *t*-test showed no
190 significant difference in the mean number of requests per month between women and men
191 REs ($t_{(809.7)}=0.11$, $p=0.92$; Figure 1D), indicating no evidence for imbalanced engagement solely
192 based on RE gender in this Action. While examining the distributions of requests per month, it
193 appeared that the distribution of the men REs might have a longer tail (kurtosis men RE=2.36;
194 kurtosis women RE =1.28). Intuitively, a gender difference in the distribution of requests per
195 month could be due to the increased involvement of selected men REs. To examine this
196 possibility, we selected the BREs who were disproportionately engaged in initial consultations
197 relative to the BRE; that is, the 43 REs defined as the upper outliers of the population (defined
198 as higher than the 75th percentile+1.5×interquartile range), with an average of 6.9 monthly
199 consultations, relative to 2.24 on average. We find that only 10 of these especially engaged REs

200 (23%) were women. However, Levene's test for equality of variances did not show significant
201 differences between men and women RE request distributions ($F_{(1,1217)}=0.052$, $p=0.82$). As
202 such, we find no evidence for gender differences when approaching REs for initial consultation.

203

204 We then evaluated the presence of gender differences in RE responses to the initial
205 consultation request (Action 3). Compared to men REs, the response rate of women REs was
206 significantly lower (0.88 ± 0.17 compared to 0.91 ± 0.14 ; Welch's $t_{(651.4)}= 3.04$, $p=0.001$, Hedges's
207 $g=0.20$; Figure 1D). In addition, women REs took longer to respond compared to men REs
208 (1.83 ± 1.55 days vs. 1.54 ± 1.23 days; Welch's $t_{(636.3)}=-3.24$, $p=0.002$, Hedges's $g=-0.22$; Figure
209 1D). These data provide converging evidence for longer response time and less frequent
210 responses of women REs when engaging in initial consultations, in comparison to men REs.

211 [Community-facing processes in the Full Submission stage \(Action 4\)](#)

212 For manuscripts that pass the initial assessment, the Senior Editor assigns an RE who handles
213 the reviewing process (Action 4). In order to evaluate the presence of imbalances in RE
214 assignment, we first compared the number of full submissions per month handled by women
215 and men REs. A permutation Welch's t -test showed that women REs handled slightly, though
216 significantly, fewer submissions per month than men REs (0.40 ± 0.32 vs. 0.44 ± 0.37 ; $t_{(869.8)}=2.22$,
217 $p=0.026$, Hedges's $g=0.13$; Figure 2A). We next explored the effect of the Senior Editor's gender
218 on manuscript assignment to women and men REs. Using a contingency table analysis, we
219 compared the proportion of manuscripts assigned to women and to men REs as a function of
220 Senior Editor gender. Compared to RE gender base rates of manuscript assignment (6,289
221 manuscripts; women vs. men RE assigned manuscripts: 30.04% vs. 69.96%), women Senior
222 Editors assigned significantly more manuscripts to women REs (41.41% for women SEs vs.
223 30.04% for all SEs) and men Senior Editors assigned significantly more manuscripts to men REs

224 (76.57% for men SEs vs. the 69.96% for all SEs; $\chi^2_{(1)}=224.55$, $p<0.001$, contingency coefficient
225 0.186; Figure 2B). These results demonstrate that both women and men SEs are more likely to
226 assign papers to REs of the same gender relative to the gender base rates.

227

228 In order to examine how this manifestation of gender homophily might vary across disciplines,
229 we next divided the manuscripts according to the disciplines the authors assigned to their
230 submission (up to 2 out of 18 suggested discipline categories; see Table 1). We repeated the
231 contingency table analysis for each discipline separately and found a significant homophily
232 effect of Senior Editor gender on the gender of the assigned RE in 14 out of the 18 disciplines
233 (78%; Contingency table analysis with FDR correction for multiple comparisons; see Table 1 for
234 details). Figure 2C shows the gender homophily in RE manuscript assignment across all
235 manuscript discipline categories. These results demonstrate that gender homophily in
236 manuscript assignment is a widespread cross-disciplinary effect.

237

238 Previous research suggests that homophily effects negatively associate with the extent of
239 gender imbalance [54]. Accordingly, we next explored associations between homophily in
240 manuscript assignments and gender across disciplines (Figure 2D). For each discipline, we first
241 defined Senior Editor homophily as the difference between (i) the proportion of manuscripts
242 assigned to men REs by men Senior Editors and (ii) the proportion assigned to men REs by
243 women Senior Editors. Intuitively, a value of zero indicates no gender difference between men
244 and women Senior Editor manuscript assignments, whereas a value of unity indicates that
245 Senior Editors only assign manuscripts to REs of their own gender. We similarly defined for
246 each discipline an index that we refer to as the *manuscript assignment imbalance*, which is
247 calculated as the difference between (i) the proportion of manuscripts assigned to men REs

248 and (ii) the proportion assigned to women REs. Intuitively, a value of zero indicates a fully
249 balanced discipline, whereas a value of unity indicates that manuscripts are assigned
250 exclusively to men REs. Across disciplines, the correlation between Senior Editor homophily
251 and the manuscript assignment imbalance index was negative, albeit borderline in statistical
252 significance ($r=-0.47$, $p=0.049$). A Bayesian correlation analysis also suggested only anecdotal
253 evidence in favour of a negative association ($BF_{10}=1.77$). This result provides preliminary
254 evidence that in disciplines with more equal manuscript assignment, Senior Editor homophily
255 is stronger, in line with previous research [54].
256 <http://www.python.org>).

	Discipline	# MS	Base rate of M RE MS	M Senior Editor: % M RE MS	W Senior Editor: % M RE MS	X ² ₍₁₎	p *significant FDR corrected	Cramer's V
1	'Neuroscience'	2183	66.70	70.95	60.54	25.76	<0.001*	0.11
2	'Cell Biology'	1089	69.51	76.96	56.64	49.23	<0.001*	0.21
3	'Developmental Biology'	802	56.86	70.43	42.23	64.93	<0.001*	0.29
4	'Structural Biology & Molecular Biophysics'	602	79.40	83.98	67.27	20.45	<0.001*	0.18
5	'Microbiology & Infectious Disease'	528	65.72	74.57	58.78	14.39	<0.001*	0.17
6	'Biochemistry & Chemical Biology'	526	79.66	82.66	70.31	9.12	0.003*	0.13
7	'Chromosomes & Gene Expression'	476	73.53	80.40	61.71	19.85	<0.001*	0.20
8	'Genetics & Genomics'	415	74.22	82.31	60.65	23.81	<0.001*	0.24
9	'Computational & Systems Biology'	396	70.20	81.66	54.49	34.08	<0.001*	0.29
10	'Immunology & Inflammation'	316	78.48	79.25	74.51	0.57	0.451	0.03
11	'Cancer Biology'	274	78.83	82.63	65.57	8.27	0.004*	0.17
12	'Medicine'	260	71.15	75.44	62.92	4.47	0.035*	0.04
13	'Evolutionary Biology'	223	75.34	82.84	64.05	10.16	0.001*	0.21
14	'Physics of Living Systems'	205	86.34	86.93	84.61	0.18	0.675	0.03
15	'Plant Biology'	152	73.68	74.32	50.00	1.19	0.276	0.11
16	'Ecology'	140	77.86	82.91	52.17	10.53	0.001*	0.27
17	'Epidemiology & Global Health'	117	72.65	74.00	64.71	0.63	0.427	0.07
18	'Stem Cells & Regenerative Medicine'	102	65.69	79.17	53.70	7.31	0.007*	0.27

257 **Table 1: Descriptive statistics and contingency table analysis of Senior Editor Homophily effect across disciplines.**

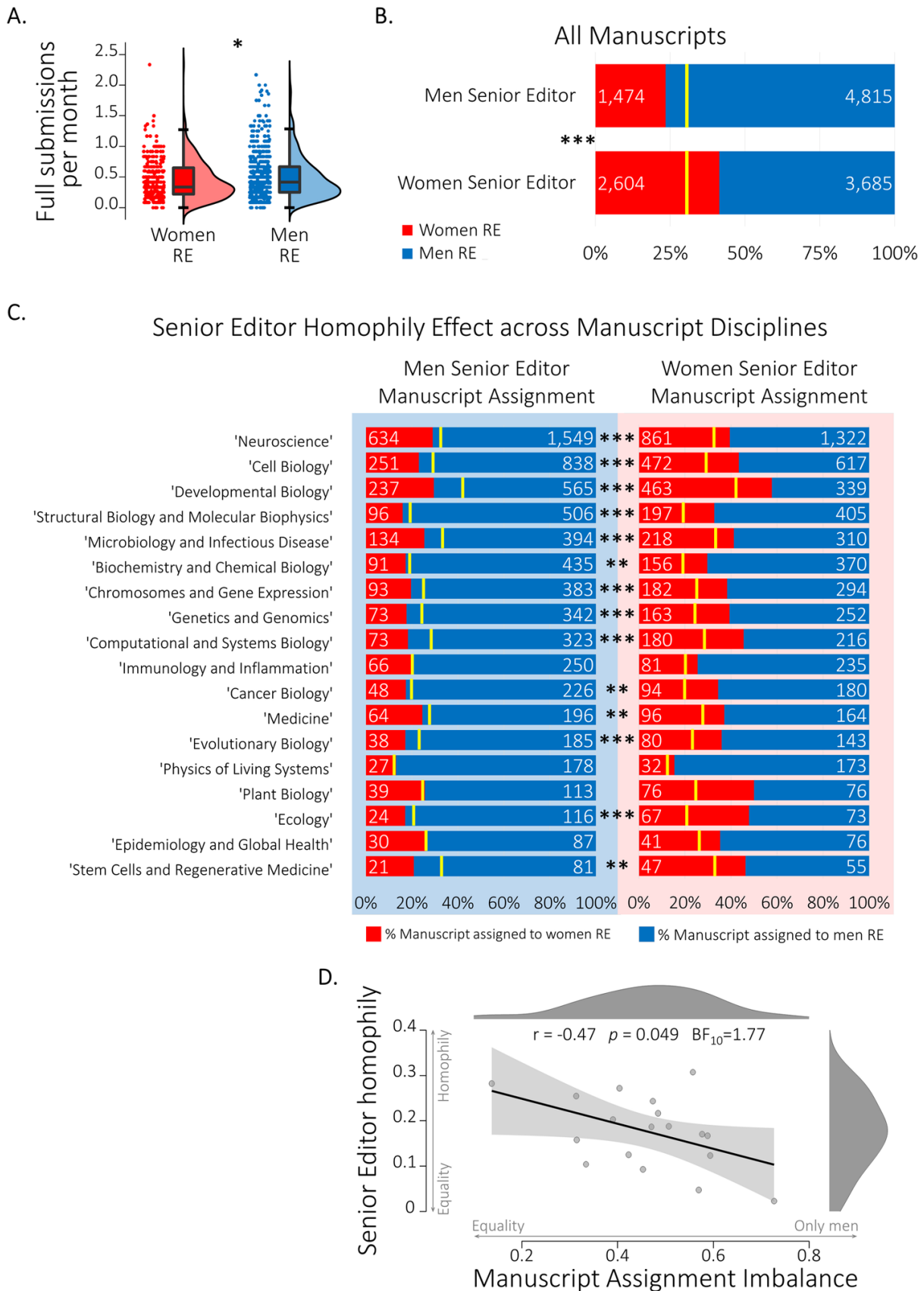
258 MS – Manuscripts; RE – Reviewing Editor; M – Men; W – Women.

259 Appeals (Action 5)

260 In our final analysis, we evaluated the presence of gender imbalances in authors' appeals
 261 (Action 5). In the Initial Assessment stage, only the identity of the Senior Editor is revealed to
 262 the authors. The difference in the rates of appeals of manuscripts handled by women and men

263 Senior Editors in the Initial Assessment was marginal; we observed a trend towards fewer
264 appeals over women Senior Editors' assessments, but this trend did not reach statistical
265 significance (Contingency table analysis, $\chi^2_{(1)}=3.781$, $p=0.052$, Contingency coefficient=0.013;
266 Figure 1E). Moreover, a Bayesian Contingency table analysis suggested moderate evidence in
267 favour of the null hypothesis ($BF_{10}=0.28$), confirming the lack of difference in Senior Editor
268 gender in Initial Assessment appeals. In the Full Submission stage, the identities of both the
269 Senior Editor and the handling RE are revealed to the authors. Dovetailing with the Initial
270 appeals findings, the gender difference in the rates of appeals for the final decision for both
271 Senior Editors and REs did not reach significance (Senior Editor gender: Contingency analysis,
272 $\chi^2_{(1)}=0.34$, $p=0.58$; RE gender: Contingency analysis, $\chi^2_{(1)}=1.69$, $p=0.19$; Figure 1E). These results
273 suggest that in general, authors' tendency to appeal does not seem to depend on the gender
274 of the Senior Editor and handling RE. It is important to note, however, that the small rate of
275 appeals limits the robustness of this finding: we observed 809 initial assessment appeals out
276 of 24018 initial submissions (3.4%), and 417 final decision appeals out of 6289 fully submitted
277 manuscripts (6.6%).

4 Full submission



278
279
280

Figure 2: Gender disparities in eLife during Full Submission (Action 4). A. Men REs (blue) handle slightly more full submissions per month than women REs (red). B. Compared to manuscript assignment gender base rates (yellow)

281 lines; Base rate of RE manuscript assignment: Women– 30.04%; Men– 69.96%;), Men Senior Editors (SE, top)
282 assign significantly more manuscripts to men REs (blue; 76.57%) and women Senior Editors (bottom) assign
283 significantly more manuscripts to women REs (red; 41.41%). **C.** SE-BRE Manuscript assignment homophily is
284 prevalent across disciplines. The effect of Senior Editor gender on the assigned RE’s gender across manuscript
285 disciplines, showing preferential assignment of men REs (blue) by men Senior Editors (left) and of women REs
286 (red) by women Senior Editors (right), compared to the gender base rate of RE manuscript assignment (yellow
287 lines; p values are FDR corrected). **D.** A scatter plot showing the correlation between the Senior Editor homophily
288 effect (the difference in the rate of manuscripts assigned to men REs when the Senior Editor is a man and when
289 the Senior Editor is a woman) and the Manuscript Assignment Imbalance (the difference in the rate of manuscripts
290 assigned to men REs versus to women REs), across disciplines (Pearson $r=-0.47$, $p=0.049$, $BF_{10}=1.77$). Shaded area
291 depicts the 95% confidence interval. $*p\leq 0.05$, $**p\leq 0.01$, $***p\leq 0.001$.
292

293 Discussion

294 Gender imbalance in the scientific publishing process is already evident when considering
295 simple numerical disparities, starting with women’s representation in scientific editorial boards
296 [67–73], number of invited articles [18,19,21], frequency of being asked to referee [75–77],
297 published manuscripts’ topics [34], and number of publications [36,37,78]. Here we extend the
298 scope of this disparity by reporting clear under-representation of women in the BRE of a
299 prominent biomedical journal (eLife). Beyond numerical proportions, the eLife dataset allowed
300 us to examine whether the various actions that make up the editorial process are related to RE
301 gender. We find that gender disparity stretches well beyond the known numerical imbalance,
302 hinting at gender biases influencing the editorial process. Moreover, in a number of cases,
303 gender disparity effects were large in magnitude. The gender disparity is first exerted by
304 external influence—authors suggest more men from the pool of REs, even after correcting for
305 men’s numerical over-representation in the BRE. We also see gender disparity within eLife, in
306 terms of the RE’s bidirectional engagement during the internal initial assessment of
307 submissions. Perhaps most strikingly, we find a robust homophily effect when assigning REs to
308 lead the community-facing role of the editorial peer review. Each of these gender disparity
309 effects is compatible with previous research demonstrating systematic biases in STEM.

310 Where we add to this body of knowledge is by uncovering the internal working of editorial
311 decisions that will impact the participation and contribution of women. By revealing multiple
312 contributing factors that exacerbate the existing imbalance, our findings highlight the need to
313 assess and correct gender disparities in terms of the *contribution* to the editorial process
314 (equity) and not just in terms of proportional *representation* (equality). It is our hope that a
315 better understanding of these mechanisms will help reduce the biases that we document.

316

317 **The eLife dataset**

318 Before we discuss our key findings, it is important to consider our unique dataset and the
319 potential advantages and limitations inherent to it. As detailed in the Methods section, we used
320 anonymous analytics collected by eLife's editorial platform for monitoring purposes. This rich
321 dataset reflects a real-life process, and spans a relatively large range of biological disciplines
322 and international contributing scientists and editors. During the investigation period, eLife had
323 a similar fraction of women in their BRE relative to other editorial boards [73], suggesting that
324 the issues identified here are likely to be observed in other journals. However, the specific
325 factors that we could study were not pre-determined based on our experimental needs.
326 Accordingly, we were limited in our explanatory power, both in terms of other relevant factors
327 that might be contributing to the observed effects (e.g., the level of seniority of each RE) and
328 in terms of the statistical power (e.g., authors' appeals are rather infrequent). To mitigate some
329 of these gaps, we can gain some insight from more recent data relating to the heterogeneity
330 of eLife's BRE (see Supplemental Section, Fig. S1), although these recent analytics may not fully
331 represent the dataset we analysed here. It is also important to consider the makeup of the
332 BRE; these are invited roles, and as such, all the REs are established in their subfields. However,
333 due to issues we expand upon below, it is possible that women REs are less senior than men

334 REs, as described in the Supplemental data. Unfortunately, the fact that our primary datasets
335 lack direct information on academic attainment levels for all women and men is a limitation.
336 This lack of information should not be interpreted to mean that academic status is equal across
337 genders in our datasets, an assumption that is likely to be incorrect. The sociology of gendered
338 behavior predicts that both academic status and gender likely influenced the outcome of the
339 interaction in which manuscripts were evaluated, as discussed below. We also do not have
340 data on the intersectionality of gender with other primary sources of disparity (e.g., geographic
341 location, race, ethnicity, class, sexual orientation, and ability [79–82]). Yet, the results of a
342 recent eLife self-report survey conducted outside our study period suggest that women serving
343 as editors are more likely to also self-identify as belonging to an underrepresented or minority
344 group based on their race or ethnicity [83]. Finally, as described in the Methods section,
345 perceived gender was assigned as “man” or “woman” (without distinguishing trans from cis)
346 based on the REs’ names and public profiles, and hence may or may not reflect the BRE’s true
347 gender identity. Although eLife recent data suggest that the vast majority of the BRE is cis [83],
348 gender identity was not measured along and outside the binary (e.g., nonbinary, genderfluid,
349 etc.). With these points in mind, our gender effects might be modulated by other contributing
350 factors that should be investigated in future research in greater detail.

351

352 **Gender disparities**

353 We first considered gender differences in REs bidirectional engagement, including both
354 invitations to contribute to the initial editorial consultation by the Senior Editors and the
355 individuals’ participation in response. We define this process as internally-facing because the
356 identity of the REs involved is only revealed to the other editors engaged in the consultation.
357 We did not find significant differences in the number of invitations of women REs by the Senior

358 Editors to participate in initial consultations relative to men REs. However, we did observe a
359 heavy-tailed, skewed distribution of consultations, such that there is a small group, mostly
360 comprised of men, that disproportionately dominates initial consultations. Even if the
361 differential proportions of these groups are not statistically significant, this small men-
362 dominated group might still skew diversity [84,85]. To distribute the influence more fairly, a
363 potential solution is to cap the number of consultations per individual RE.

364

365 Although the number of initial invitations did not differ between women and men, women
366 engaged less with invitations from the SEs, resulting in the under-involvement of women in
367 editorial activities. Women took only slightly longer to respond relative to men (women were
368 approximately 7 hours slower to answer emailed invitations), but considering the interactive
369 nature of the consultation process, this delay could be meaningful. In the eLife initial
370 consultation process, where editors' interact in an on-line instant chatting format, this means
371 that men are more likely to set the tone of the discussion by providing their opinion first,
372 making it more difficult for women, on average, to influence the editorial decision (through
373 conformity and anchoring cognitive biases for example [86–88]). It has been previously shown
374 that it is more difficult to voice a different opinion once an opinion has been formed [89,90].
375 The delayed response, as well as reduced response rate (by approximately 3%) could
376 potentially be attributed to the fact that women have more duties and responsibilities than
377 men REs. There are multiple reasons to suggest this, depending on women's specific
378 intersecting identities [43,91,92]. For example, senior women are overburdened by
379 administrative responsibilities due to the institutional need to narrow the gender gap [25,30].
380 More specifically to our dataset, there is a hint that women REs are at an earlier career stage
381 relative to men (Supplementary section), and hence may be more likely to have children at

382 home than their men colleagues and thus face an added burden on their time [43], or be more
383 laden with obtaining tenure. Another potential contributing factor is the higher standard of
384 communication women are held to in order to receive equal acknowledgment, resulting in an
385 imposed time-consuming quantity/quality trade-off for women, and reducing their
386 productivity [47,93,94]. Irrespective of the reasons, our results signal that the journal
387 submission and review process needs to shift away from monitoring decisions based on the
388 decision time, which adds time pressure, and instead could potentially delay discussion and/or
389 decisions about submissions until women have contributed.

390

391 We did find a significant difference in the engagement of women REs when considering
392 community-facing duties, particularly when leading the peer-review process. Specifically,
393 women were assigned 9% fewer manuscripts relative to men. This effect is likely exacerbated
394 by the longer response time and less frequent responses we observed during initial
395 consultations, as the assignment of the reviewing RE is often determined during the initial
396 consultation. We are hopeful that if the bias in the previous stage is corrected then the under-
397 assignment of full submissions to women REs will be improved. However, it is also important
398 to consider more carefully other potential sources of bias and how to mitigate them. For
399 example, it is also possible that men might volunteer more readily to take up this time-
400 consuming role – our data does not allow us to shed any light on the inner discussions beyond
401 response time. Regardless, our effect is consistent with other studies showing that women are
402 disproportionately engaged in internal-institutional facing duties, whereas men are
403 disproportionately engaged in community-facing roles, which are also more associated with
404 eminence, networking, and other benefits related to the more visible duties of the reviewing
405 RE leading the peer review [11,12,14]. The reasons underlying this pattern should be further

406 studied, however women's different time allocation may reflect a purposeful choice to
407 contribute to their institutions. Another potential driver could be inherent biases of the Senior
408 Editor assigning the RE; research shows that women are less frequently approached to apply
409 for awards, write invited reviews, etc. [11,13,19,21,75]. Within the context of editorial
410 assignments, this effect could be potentially corrected by providing gender-specific statistics
411 to the Senior Editors about disproportional engagement by gender. We turn to consider
412 gender-based interactions between the Senior Editor and REs in the next section.

413

414 **Homophilic Behaviours**

415 Homophily is one of the fundamental patterns underlying human relationships across multiple
416 social systems, influencing how communities form, how status is distributed, and how
417 subgroups evolve in occupations and organizations [95]. With respect to the homophily effect
418 of the Senior Editor's gender on REs assignments, we find that across multiple sub-disciplines,
419 there is a significant tendency for Senior Editors to choose same-gender REs to handle full
420 submission for peer reviews. One might wonder whether the observed homophily effects
421 might be explained by field-specific differences in gender proportions: in a discipline comprised
422 mostly by men, e.g. physics of living systems, the Senior Editor (likely a man) will more often
423 reach out to more men simply because most of the experts are men. To evaluate this possible
424 explanation, we separated our data by discipline. We found that the homophily effect exists
425 quite broadly, across 14 of the 18 disciplines (despite noticeable variability in the proportion
426 of women/men RE across disciplines, see Figure 2C), hence refuting the differently-gendered
427 subdisciplines account. What other drivers could potentially explain the homophily effect?
428 Homophily is driven by various types of associations and dimensions of similarity [96], such as
429 ascribed attributes (e.g. gender [97]), acquired attributes (e.g. occupation [98]), values,

430 attitudes, and beliefs (e.g. activism [99]). Homophily, and gender homophily in particular, are
431 prevalent in academia, for example in shaping interactions in scientific conferences [100],
432 affecting scientific collaboration and scientific societies [11,101], and biasing the selection of
433 Nobel laureates [13]. Thus, we were not surprised to find that men Senior Editors assign more
434 men REs than the women REs, even after taking into consideration the larger numerical
435 proportion of men in the BRE.

436

437 It is possible that homophily in women arises from different drivers than homophily in men
438 [67,102], due to distinct social processes [103,104] and the roles they play in intersectional
439 power structures [105]. Considering the current political climate where there is greater
440 awareness for the under-representation of women in STEMM, it is possible that women Senior
441 Editors adopt an informal policy to engage women REs disproportionately. In this respect, the
442 women homophily offsets to some degree the gender bias we see in the editorial process.
443 Activism-driven homophily among women was demonstrated for example in crowdfunding of
444 start-up projects, whereby a small proportion of women backers disproportionately supported
445 women-led projects in areas where women are historically underrepresented [99]. Similarly,
446 gender homophily in reviewer assignment by journal editors was widespread among men
447 editors, while for women only a small number of highly homophilic editors dominated [67].
448 Our data did not allow us to directly explore the prevalence of homophily among individual
449 REs, yet the fact that homophily was widespread across many fields, involving different REs,
450 suggests women homophily is a broad phenomenon in eLife. Additionally, we find that
451 homophily increases with gender balance across sub-disciplines. This echoes the finding that
452 men homophily in article citations increases as the research field gets more gender balanced
453 with time [54]. However, given that women Senior Editors are outnumbered by men (for

454 example, 36% (30) women vs. 64% (52) men Senior Editors in 2021), on average we see an
455 over-engagement of the men REs, even after accounting for their numerical dominance in the
456 BRE. One simple candidate intervention is to increase the proportion of women in senior roles,
457 which could also potentially serve to address other aspects of gender disparity that we did not
458 study here. However, for the reasons detailed above, simply increasing representation (e.g.,
459 the number of women) might not be sufficient to ensure inclusion, equity, and justice
460 [11,67,99,106,107].

461

462 Despite the fact that women display homophilic tendencies that serve to partly balance the
463 homophilic tendencies of men, we do not in general endorse homophily effects as an
464 appropriate solution to the gender bias observed here, as it can have devastating trickle-down
465 consequences. For example, it was previously shown that scientific journal editors of both
466 genders were more likely to appoint reviewers of the same gender as themselves [67].
467 Moreover, a previous study of eLife editorial decisions focused on how the gender makeup of
468 the participants in the peer-review stage – both editors and reviewers – biases acceptance
469 rates for men and women authors [53]. It was observed that all-men reviewer teams are far
470 more likely to accept men-led manuscripts. Therefore, the homophilic behaviour that we
471 observe among men is likely to exacerbate these effects and increase the gender publishing
472 gap. More generally, it was shown that homophilic groups tend to have similar evaluations and
473 mind-sets [67,108,109]. Hence, the uncontrolled effects of homophily may undermine the
474 impartiality of peer-review, and thus undermine science [67,110]. Instead, solutions should be
475 driven by formal policy that foreground equity and justice. For example, the homophily factor
476 could be monitored to help Senior Editors avoid implicit and explicit biases. Another important

477 candidate intervention for this issue is to diversify the network of the Senior Editors within the
478 BRE.

479 **Conclusion**

480 Table 2 provides a summary of our results and aims to offer potential guidance to stakeholders
481 for taking a proactive approach towards enhancing gender equity in editorial activities. We find
482 multiple consistent disparities across the editorial process, which culminate in the
483 disproportional handling of submissions for peer review by men relative to women, even after
484 taking into consideration men's over-representation in eLife's BRE. This effect was not a mere
485 consequence of different gender distribution across disciplines, meaning it is not due to lack
486 of available expert women, but rather a tendency of men SEs to favour men REs over women
487 REs. This homophily effect is known to influence editorial decision-making, e.g. in recruitment
488 of reviewers [67] and in favourable evaluation of manuscript led by men [53]. Therefore, it is
489 easy to speculate that the disparity effects we observed here would be further amplified as the
490 decision process trickles down. In other words, the gender disparity that tends to disfavour
491 women cannot be pin-pointed to a single stage in the editorial evaluation process, but should
492 instead be viewed as a systematic accumulation of biases across multiple decision-making
493 steps of a people-led process.

494 To conclude, at the time of our analysis, eLife and other scientific journals do not have a formal
495 strategy for engaging women, beyond increasing their numerical proportion. By including more
496 women in the editorial process, the hope is that their voice will be expressed and heard.
497 However, the evidence provided here suggests that simply increasing women's numbers is not
498 enough to overcome gender bias. Critically, without taking into consideration women's specific
499 work habits and availability, starting with their potentially different career demands, through
500 different work-life balance and ending with sociological preferences, it is difficult to imagine a

501 future in which the underlying mechanisms for under-engagement of women do not continue
 502 to bias the process. We therefore suggest that in order to index gender balance, we need a
 503 focus on equity rather than equality. We further suggest that informal policies, such as gender
 504 homophily, need to be replaced by formal policies that are based on educating both Senior and
 505 Reviewer Editors on how the choices that they make during editorial activities impact the
 506 gender gap.

507
 508

Effect	Potential drivers	Recommendation
Authors suggest more men REs	Explicit or implicit bias /cultural norms/ internalised stereotypes/ differences in visibility	eLife can request authors to suggest a balanced gender representation and alert authors for disproportionate recommendation
Initial consultations disproportionately involve a subgroup of REs, mainly men	Explicit or implicit bias /cultural norms/ internalised stereotypes/ differences in visibility	Cap the number of consultations per individual RE to distribute influence more fairly
Women REs take slightly longer to respond to initial consultations; Women REs respond slightly less frequently to initial consultations	Women are held to a higher standard of communication/more affected by other commitments	Decision time should not be a limiting factor, reveal feedback after all REs had an opportunity to engage; Include more women in initial consultation to account for their lower response rate
Women handle fewer full submission	Explicit or implicit bias /cultural norms/ internalised stereotypes/ differences in visibility	Offset bias in initial consultation, provide feedback on gender imbalance patterns for Senior Editors (e.g., statistics about disproportionate RE engagement by gender), diversify the network of the Senior Editors within the BRE
Homophily effect	Same-gender network; Attempt to correct societal confounds	Increase transparency and awareness to the risks of homophily in science, increase the proportion of women Senior Editors, diversify the network of the Senior Editors within the BRE

509 **Table 2: Summary of the study's main findings, speculated causes, and potential solutions.** Notice that the effects
 510 reported here were observed even after taking into consideration the reduced numerical representation of

511 women in eLife's editorial system. These proposed solutions aim to provide potential guidance to stakeholders,
512 enabling them to adopt a proactive and practical approach towards enhancing gender equity in editorial activities.

513 MATERIALS AND METHODS

514 In this methods section, we first provide a detailed description of eLife's peer review process,
515 before describing the data we study and the statistical methods we employ.

516

517 [eLife's peer review process](#)

518 eLife holds a unique two-stage evaluation process, as detailed in Figure 1A. The first stage is
519 the initial assessment, and the second stage is peer review. We will describe each in turn, along
520 with the series of actions it comprises.

521

522 Initial Assessment stage. In the first stage, submitted manuscripts are evaluated by a team of
523 editors with related expertise. A Senior Editor solicits the advice of one or several REs in order
524 to determine whether the manuscript is suitable for peer review. The process of soliciting and
525 receiving advice is carried out in an interactive consultation forum between all involved
526 participants. Thus, the role of the RE at this stage is internal. The outcome of this process is
527 communicated to the author in a letter signed by the Senior Editor. As such, the identity of the
528 advising RE(s) is only known internally. To help the Senior Editor identify the most relevant
529 members of the BRE to solicit as an advising RE, the authors are invited to suggest REs as part
530 of their initial submission.

531

532 Peer Review stage. For papers that are invited for full review, an RE is chosen to manage the
533 process by overseeing the reviewer selection and by coordinating an open discussion between
534 the reviewers, the handling Senior Editor, and the RE once all individual reviewer reports have
535 been submitted. The RE is also encouraged to provide their own independent review as one of

536 the peer reviewers. The RE facilitates the discussion and drafts a final decision either rejecting
537 the paper or requesting the necessary revisions to support the acceptance of the paper. The
538 identity of the RE is revealed not only to the reviewers in the discussion, but also to any other
539 experts that were invited to take part in the peer-review process. Both Senior and Reviewing
540 Editors sign the decision letter, and if the paper is published with eLife, they are also named as
541 editors on the published manuscript. As such, the role of the RE at this stage is community-
542 facing.

543

544 Post-rejection. In the event that a paper is rejected at either stage of the editorial process, the
545 author(s) can appeal the editorial decision.

546

547 **Data**

548 Data accumulated by eLife’s platform for science publishing over the years 2017-2019 were
549 organised into two datasets, as summarised in Table 3. The first dataset will be referred to as
550 the BRE dataset, and the second will be referred to as the Manuscript dataset. We will describe
551 each in turn. But first we make a note on assigned gender.

552

553 *Gender assignment.* In all cases, Editor gender was assigned by eLife’s staff based on the
554 editor’s name and gender expression. Note that staff (i) assigned a binary “man” or “woman”
555 gender, (ii) did not distinguish between trans and cis identities, and (iii) did not assign other
556 genders such as nonbinary, genderqueer, agender, or genderfluid. Note that any editor could
557 have a gender different from the one that was assigned, and that true gender may or may not
558 be more widely known by the community for several reasons: (i) scientists might be closeted
559 due to the pervasive violence and discrimination faced by gender minorities, (ii) scientists

560 might share their true gender identity only with a few close colleagues or friends, or (iii)
561 scientists might share their identity freely but because of the complexity of the social network
562 landscape in science, that information may not have reached all other scientists in their field.
563 Accordingly, the staff's assignment of gender therefore reflects not self-identity but rather the
564 perceived binary gender of the person. This perception is likely to also be held by the majority
565 of the broader community, and hence is particularly relevant to understanding how the editor
566 might be treated by that community (e.g., the frequency with which they might be suggested
567 as a Reviewing Editor by authors). We also note that since early 2020, eLife has given all Senior
568 and Reviewing Editors the option of sharing their self-reported gender identity via a
569 confidential survey. However, the current response rate (~40%) precludes a comprehensive
570 analysis of gender disparities using the data at this stage [83].

571

572 *BRE dataset.* This dataset includes anonymous information relating to the engagement of
573 individual REs in the editorial process. This information includes the start and end dates of their
574 editorial contracts, the number of consultations in which they have been invited to participate,
575 how responsive they are to consultation requests (number of responses and response rate),
576 the number of full submissions assigned, and how many days they take to make an editorial
577 decision. In addition, the editorial staff asks REs to provide a set of keywords that reflect the
578 scope of their research, which was also included in this dataset. Note that the terminology was
579 self-generated by the REs (rather than adopted from an existing database), and that there were
580 no limitations on the number of keywords each RE could provide. For some REs, additional
581 keywords are added by the editorial staff based on the information publicly available on the
582 editors' academic websites.

583

584 *Manuscript dataset*. This dataset includes information relating to each manuscript submission,
585 detailing the manuscript's outcome in each of the submission stages. This dataset also contains
586 the assigned gender (as described above) of those BRE members that were suggested by the
587 authors, the recorded gender of the handling RE, and the recorded gender of the assigned
588 Senior Editor. Note that here our information regarding gender pertains only to the editorial
589 team handling the manuscripts and not to the manuscript authors, whose identities were not
590 made available for the present study due to ethical considerations (though we note that the
591 authors' identity, but not necessarily their self-defined gender, was known to the editors
592 involved in the assessment). Manuscripts with appeals received after the Initial Submission and
593 without a Full Submission decision were most likely rejected prior to review. It is possible that
594 a small fraction of manuscripts was withdrawn prior to evaluation; however, we did not have
595 access to such data.

596

597 Additionally, this dataset contains up to two (out of 18) disciplines that the authors assigned
598 to their manuscript upon submission. Options included 'Neuroscience', 'Cell Biology',
599 'Developmental Biology', 'Structural Biology and Molecular Biophysics', 'Microbiology and
600 Infectious Disease', 'Biochemistry and Chemical Biology', 'Chromosomes and Gene Expression',
601 'Genetics and Genomics', 'Computational and Systems Biology', 'Immunology and
602 Inflammation', 'Cancer Biology', 'Medicine', 'Evolutionary Biology', 'Physics of Living Systems',
603 'Plant Biology', 'Ecology', 'Epidemiology and Global Health', and 'Stem Cells and Regenerative
604 Medicine' (Manuscript Dataset; see Tables 1 & 2). In order to analyse the manuscript data
605 across disciplines, we assigned to each discipline all the manuscripts in which a discipline was
606 chosen at submission. This process created some overlap between disciplines (6289 fully

607 submitted manuscripts; 1979 manuscripts were assigned to two disciplines out of 8268
608 assigned manuscripts, or 23.9%).
609

BRE dataset			
Year	2017	2018	2019
N	328	376	497
Days to respond			
Mean	1.517	1.613	1.723
Std. Deviation	1.165	1.277	1.49
Minimum	0.022	0.014	0.025
Maximum	7.958	8.902	12.974
Response rate			
Mean	0.915	0.897	0.899
Std. Deviation	0.114	0.15	0.162
Minimum	0.389	0	0
Maximum	1	1	1
# Requests per month			
Mean	2.462	2.336	2.419
Std. Deviation	1.471	1.421	1.549
Minimum	0	0	0
Maximum	9.083	9.091	9.2
# Full submissions per month			
Mean	0.463	0.415	0.41
Std. Deviation	0.374	0.343	0.349
Minimum	0	0	0
Maximum	2.333	2	1.9
Keywords			

Manuscript dataset			
Year	2017	2018	2019
N (Total = 24056)	7514	7670	8872
Full submission (Total = 6289)	1976	1948	1413
% of Men Suggested BRE members			
Gender of Senior Editor			
Gender of handling RE			
Initial appeal rate (only Senior Editors)			
Full decision appeal rate (Senior Editors and REs)			
Discipline 1 (18 possible disciplines)			
Discipline 2 (18 possible disciplines)			

610 **Table 3: eLife datasets.** Top: BRE Dataset: contains information relating to the engagement of individual BRE
611 members in the editorial process (identified by gender and year). It includes the following fields: The mean
612 number of days until the Reviewing Editor (RE) responded to a Senior Editor's request to participate in the Initial
613 Assessment stage (Days to respond); The RE response rate to Initial Assessment consultation requests (Response
614 Rate); The mean number of consultation requests per month each RE received (# Requests per month); The mean
615 number of full submissions per month each RE handled (# Full submissions per month); The keywords associated
616 with each RE to showcase their expertise (Keywords). Note that the number of full submissions may contain
617 papers that the REs had handled as Guest Editors in the year prior to joining the BRE. Also, some REs may have
618 been on leave, and therefore may have not been consulted for a certain period. Bottom: Manuscript Dataset:
619 contains information relating to each manuscript submission, detailing the manuscript's outcome in each of the
620 reviewing process stages (identified by gender of the Senior and Reviewing Editors). It includes the following

621 fields: The proportion of men BRE members suggested by the authors (% of Men BRE members); The gender of
622 the Senior Editor handling the manuscript throughout the reviewing process (Gender of Senior Editor); The gender
623 of the RE handling the manuscript in the Full Submission stage (Gender of handling RE); The rate of author appeals
624 at the Initial Assessment stage in which only the Senior Editor identity is revealed to the authors (Initial appeal
625 rate); The rate of author appeals at the Full Submission stage in which both the Senior and Reviewing Editors'
626 identities are revealed to the authors (Initial appeal rate); The two discipline terms the authors chose, out of 18
627 possible terms (Discipline 1 & Discipline 2; see Table 1 for details).
628

629 [Ethics statement](#)

630 eLife's submission guidelines notifies authors that eLife undertakes research and surveys
631 relating to the submission and review process periodically, and that participation does not
632 affect the decision on manuscripts under consideration, or any policies relating to the
633 confidentiality of the review process. Authors who do not wish to participate can opt out of
634 eLife's research and/or surveys. Ethical approval to analyse and share the anonymised data
635 was given by Goldsmiths, University of London's Research Ethics Committee.

636

637 [Data analysis](#)

638 We applied several exclusion criteria to the data before proceeding with further analysis. In
639 the BRE dataset, we excluded REs who became Senior Editors, or resigned as Senior Editors
640 (and became REs) in a given year, or those who were inactive (i.e., were never contacted on
641 initial submissions). In addition, in the manuscript dataset, we limited the number of author-
642 suggested REs to five per manuscript; and excluded papers handled by guest editors as well as
643 Research Advances, Registered Reports, and formats that go through a different workflow.

644

645 [Statistical analysis](#)

646 Results are reported as mean \pm standard deviation (StD). Owing to several non-normal
647 distributions in the data, we used non-parametric tests in all analyses. Binomial tests and $N-1$

648 χ^2 proportion comparison tests were performed to compare one or two proportions using JASP
649 (JASP Team (2020) Version 0.14) and MedCalc online tools (MedCalc Software, Ostend,
650 Belgium), respectively. Contingency table analysis was used for testing the interrelation
651 between binary variables using JASP software. When comparing the means of two groups with
652 unequal sample sizes, we used a permutation-based Welch's independent *t*-test (10,000
653 permutations) in MATLAB (PERMUTOOLS package, The Math Works, Inc. MATLAB. Version
654 2020a, The Math Works, Inc., 2020. Computer Software. www.mathworks.com/). Pearson
655 correlation coefficients were computed using JASP in order to test the association between
656 continuous scale variables, after checking for normality assumption violations using the
657 Shapiro-Wilk test for bivariate normality. When relevant, all tests were conducted using 2-
658 tailed tests. We used Hedges's *g* ($g = \frac{\bar{X}_1 - \bar{X}_2}{SD_{pooled}^*}$) to compute effect size when comparing two
659 means in a permutation Welch's *t*-test, and Cohen's *h* ($h = 2 \sin^{-1} \sqrt{p_1} - 2 \sin^{-1} \sqrt{p_2}$) when
660 comparing two proportions in a N-1 χ^2 proportion comparison test. When effects were close
661 to the critical alpha ($p < 0.05$), we conducted equivalent Bayesian analyses, with default prior
662 settings (Bayesian correlation stretched beta prior width=1; Bayesian Contingency tables, prior
663 concentration=1) using JASP to test whether there was more evidence for H_0 or for H_1 . In order
664 to measure BRE members service contribution (BRE service) as a function of gender, we
665 computed the number of months in which the RE was affiliated with the BRE per year, i.e. the
666 proportion of months of service of women and men REs out of the total number of service
667 months, thus accounting for variability in BRE service contract durations and partial work time
668 (e.g. REs appointed in the middle of the year, being on leave).

669

670 Keyword analysis

671 To investigate whether gender disparities were associated with REs' expertise, as advertised
672 by eLife to prospective authors, we conducted an analysis of the relative scope and reach of
673 the REs' keywords, broken down by the recorded gender of the RE. Keywords for each RE were
674 extracted and strung together using the 'OR' operator and then queried against the PubMed
675 database through NCBI's public API—'Entrez Programming Utilities (E-utilities)' (Entrez
676 Programming Utilities Help [Internet]. Bethesda (MD): National Center for Biotechnology
677 Information (US); 2010-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK25501/>).
678 The number of search results for each set of RE keywords was recorded and used as a measure
679 of the reach of the keywords provided by the REs, as evidenced by published papers related to
680 the keywords in the literature. The E-Utilities API was accessed through a script in Python
681 (Python Software Foundation. Python Language Reference, version 3.9.6. Available at

682

683 Supplementary data

684 Supplementary methods

685 Datasets

686 To get some intuition about potential demographic factors that could mitigate gender
687 disparities observed in our data, we analysed two additional datasets.

688 [Senior Editor Dataset](#) – This dataset contains information relating to the assigned gender (as
689 described in the Methods section) of eLife Senior Editors, including Editor-in chief and Deputy
690 Editors, who act as Senior Editors in the reviewing process. These data were extracted from
691 eLife’s website (eLife leadership team (2021), retrieved from
692 <https://elifesciences.org/about/people>).

693 [BRE demographic dataset](#) – This dataset contains anonymous information relating to the
694 assigned gender of REs (as described above), their continent of residence, as inferred by the
695 location of the institution where they are primarily based, and their career stage (number of
696 years since independence). These analytic data were acquired by eLife during February 2019,
697 January 2020, and December 2020. RE career-stage was divided into three categories: Early
698 career (less than or equal to 5 years of independence), Mid-career (6-15 years of
699 independence), and Late career (more than 16 years of independence).

700 [Statistical analysis](#)

701 $N-1$ χ^2 proportion comparison test was performed to compare the gender proportions of
702 Senior Editors MedCalc online tools (MedCalc Software, Ostend, Belgium), and contingency
703 table analysis was used for testing the interrelation between RE gender and Career stage, and
704 between RE gender and Continent of residence, using JASP software.

705 [Supplementary results](#)

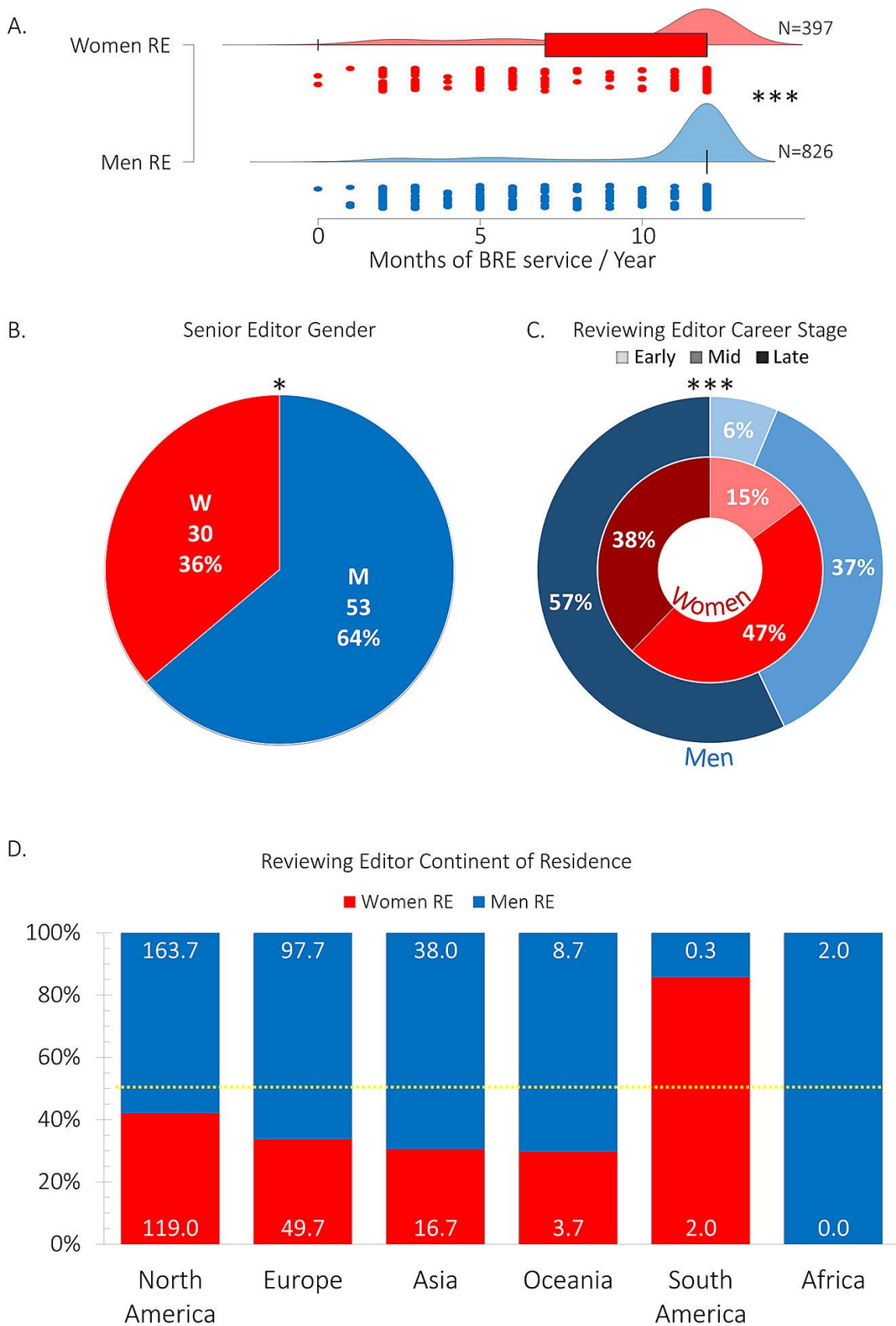
706 Woman REs served on average less months per year as active BRE members compared to men
707 REs (Women: 9.65 ± 3.60 months of service per year; Men: 10.52 ± 2.97 months of service per
708 year; Welch t-test: $t(663.91) = 4.18$, $p < 0.001$, Hedges’ $g = 0.26$; Supp Figure 1A). This difference
709 might reflect eLife’s progressive efforts to increase the number of women REs over the months
710 of the year.

711 There was a significant imbalance in Senior Editor's gender (36% women vs. 64% men,
712 $\chi^2_{(1)}=5.848, p=0.016$, Cohen's $h=0.56$; Supp Figure 1B).

713 There was a significant disparity in the career stage distribution between men and women REs:
714 women REs tended to be at earlier career stages than men REs (women: Early 14.95%, Mid
715 47.27%, Late 37.78%; Men: Early 6.34%, Mid 36.60%, Late 57.06%; $\chi^2_{(2)}=56.04, p<0.001$,
716 Contingency coefficient=0.20; Supp Fig.1C). In contrast, there was no evidence for gender
717 disparity in the geographical representation of women and men REs ($\chi^2_{(5)}=8.36, p=0.14$; Supp
718 Fig.1D).

719 Note that these findings are based on data that was sampled at a different time point than our
720 main datasets, and thus cannot be directly linked to the main findings.

721



722

723

Supplementary Figure 1: Additional information of the intersectionality of eLife's editorial team,

724

retrospective analysis. A. Women Reviewing Editors ($N=397$) serve on average slightly fewer months per year

725 as active BRE members than men ($N=826$) do, throughout 2017-2019. **B.** Senior Editor gender base rate. In 2021
726 there were significantly more men ($N=53$) than women ($N=30$) Senior Editors, as indicated by the asterisk. **C.**
727 Men and women Reviewing Editors career stage. Compared to men REs, women REs were at earlier career stages,
728 as indicated by asterisks. Note that these findings are based on data that was sampled at a different time point than
729 our main datasets, and thus cannot be directly linked to the main findings. **D.** Reviewing Editor continent of
730 residence. Numbers indicate the mean number of women and men REs from each continent across the three
731 datasets (February 2019, January 2020 and December 2020); dashed yellow line depicts gender balance (50%).
732 There was no evidence for gender disparity in the geographical representation of women and men REs. **A-C.** Men-
733 blue, women-red; * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

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740 Diversity Statement

741 Recent work in several fields of science has identified a bias in citation practices such that
742 papers from women and other minority scholars are under-cited relative to the number of such
743 papers in the field [54,56–63]. Here we sought to proactively consider choosing references that
744 reflect the diversity of the field in thought, form of contribution, gender, race, ethnicity, and
745 other factors. First, we obtained the predicted gender of the first and last author of each
746 reference by using databases that store the probability of a first name being carried by a
747 woman [54,111]. By this measure (and excluding self-citations to the first and last authors of
748 our current paper), our references contain 30.62% woman(first)/woman(last), 22.82%
749 man/woman, 18.14% woman/man, and 28.42% man/man. This method is limited in that a)

750 names, pronouns, and social media profiles used to construct the databases may not, in every
751 case, be indicative of gender identity and b) it cannot account for intersex, non-binary, or
752 transgender people. Second, we obtained predicted racial/ethnic category of the first and last
753 author of each reference by databases that store the probability of a first and last name being
754 carried by an author of color [112,113]. By this measure (and excluding self-citations), our
755 references contain 6.21% author of color (first)/author of color(last), 15.01% white
756 author/author of color, 16.03% author of color/white author, and 62.75% white author/white
757 author. This method is limited in that a) names and Florida Voter Data to make the predictions
758 may not be indicative of racial/ethnic identity, and b) it cannot account for Indigenous and
759 mixed-race authors, or those who may face differential biases due to the ambiguous
760 racialization or ethnicization of their names. We look forward to future work that could help
761 us to better understand how to support equitable practices in science.

762

763

764 Author contributions

765 Conceptualization: MJG, TRM

766 Data Curation: MJG

767 Methodology: TSM, DBT, MK

768 Investigation: TSM, MJG

769 Visualization: TSM

770 Writing—original draft: TSM, TRM

771 Writing—review & editing: TSM, DBT, MJG, DSB, TRM

772

773 Competing interests

774 We have read the journal's policy and the authors of this manuscript have the following
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777

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