

Supplementary Materials

Peer Review of Manuscripts: A Valuable yet Neglected Educational Tool for Early-Career Researchers

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Supplementary data for the manuscript entitled *Peer Review of Manuscripts: A Valuable yet Neglected Educational Tool for Early-Career Researchers*. Section 1 outlines the methodology, detailing the questions selected for both academic and ECR surveys. Both a qualitative and quantitative (statistical) analysis of the individual questions is subsequently provided. Section 2 outlines the responses to the academic survey. Section 3 provides an analysis of the responses to the student survey, and draws comparisons between the two surveys.

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1) Methodology

1.1) Academic survey questions

The academic survey was sent to academics at selected institutions in ten different countries across Europe (4 – UK, Switzerland, Germany, Netherlands), North America (2 – USA, Canada), Asia (China & Hong Kong, Japan, Singapore), and Australasia (1 – Australia). The countries, institutions, and number of responses from each country are outlined in Table S1. The total number of institutions within each country was taken into account when creating the survey list. The participants were selected randomly from university directories for all science, technology, engineering, and maths (STEM) fields. Two-hundred survey invitations were sent to academics in each country, for a total of 2000 issued invitations. Some responses were received from academics at universities outside the selected survey lists; the survey's circulation among universities by the academic participants indicates a promising interest in the survey subject. In total, 950 responses spanning 71 different institutions were received. The questions selected for the academic survey are given below:

- 1) What is the name of your institute/university?
- 2) How many peer review invitations do you typically accept in a one-month period?
- 3) Have you ever offered a postgraduate (PGR) student under your supervision the opportunity to peer review a manuscript? a) yes; b) no
- 4) If yes (Q2), what is your motivation for offering PGR students under your supervision the opportunity to peer review a manuscript? (Please rank each option 1-5, 1 – most important reason, 5 – least important reason)
 - a) To alleviate your workload
 - b) To help complete the review within a time deadline
 - c) To increase the students' expertise in a relevant field
 - d) To familiarise the student with the publication process
 - e) To familiarise the student with journal-style writing
- 5) If no (Q2), what is your motivation for NOT offering PGR students under your supervision the opportunity to peer review a manuscript? (Please rank each option 1-5, 1 – most important reason, 5 – least important reason)
 - a) You would rather them focus on their research
 - b) Due to their lack of experience with the publication process
 - c) You do not feel that peer review is a beneficial practice for PGR students
 - d) You do not have the time to teach them about the review process
 - e) You do not have the time to give feedback on their review
- 6) In your experience, what educational value does peer review have on the following skills? (Please score these answers on a scale of 0-10, 0 – No educational value, 10 – Maximum Educational Value)
 - a) Planning
 - b) Journal-Style Writing
 - c) Experimental Procedure
 - d) Critical Thinking
 - e) Working to Deadlines
 - f) Proofreading
 - g) Shaping Research
 - h) Ethical Expectations

1.2) ECR survey questions

The ECR survey was circulated mainly by academic supervisors who participated in the survey. While the survey was also circulated through the selected institutions using departmental mailing lists, the response rate was much lower. In total, 253 responses to the ECR survey were received. Since fewer responses were received compared with the academic survey, country and institution data were not gathered for the ECR survey. The questions selected for the ECR survey are given below:

- 1) What is the name of your institute/university?
- 2) Do you get invited to peer review manuscripts for academic journals?
- 3) If yes (Q2), give the approximate number of manuscripts per year.
- 4) If your supervisor invited you to assist with peer reviewing academic manuscripts, what do you think is their motivation for inviting you to assist the review? Please rank the following reasons from 1-5 (1 – most relevant reason, 5 – least relevant reason). For the ones that do not apply, leave the boxes blank. If you do not participate in peer review, leave this question blank and move to the next question.
 - a) To alleviate their workload
 - b) To help complete the review within a time deadline
 - c) To increase the students' expertise in a relevant field
 - d) To familiarise the student with the publication process
 - e) To familiarise the student with journal-style writing
- 5) If your supervisor does not involve you in the peer review process, rank the main reasons for NOT inviting PGR students to peer review manuscripts, from 1-5 (1 – most relevant reason, 5 – least relevant reason).
 - a) They would rather you focus on your research
 - b) Due to your lack of experience with the publication process
 - c) They do not feel that peer review is a beneficial practice for PGR students
 - d) They do not have the time to teach you about the review process
 - e) They do not have the time to give feedback on your review
 - f) Don't know why they don't invite students
- 6) In your experience, what educational value does peer review have on the following skills in PGR students? (Please score the answers on a scale of 0 – 10; with 0 – No educational value, 10 – Maximum Educational Value)
 - a) Planning
 - b) Journal-Style Writing
 - c) Experimental Procedure
 - d) Critical Thinking
 - e) Working to Deadlines
 - f) Proofreading
 - g) Shaping Research
 - h) Ethical Expectations

- 7) If your supervisor involves you in peer reviewing academic manuscripts, are you aware if the supervisor sought permission from the Editor to involve you assisting with the peer review process, and to share the manuscript with you?
- a) Yes b) No
- 8) If your supervisor involves you in peer reviewing academic manuscripts, were you given detailed instructions about confidentiality?
- a) Yes b) No
- 9) If your supervisor involves you in peer reviewing academic manuscripts, do you get feedback and constructive comments on your review from your supervisor?
- a) Yes b) No

Table S1. Countries and institutions that participated in the academic survey.

<i>Country</i>	<i>Number of Responses</i>	<i>Number of institutions represented in academic survey</i>	<i>Names of institutions represented in academic survey</i>
UK	85	10	University of Leeds, University of Durham, University of Exeter, University of Hull, University of Edinburgh, University College London, University of Bristol, University of Liverpool, University of Nottingham, University of Plymouth
USA	75	12	Caltech, Stanford University, MIT, Harvard University, University of Chicago, Johns Hopkins University, Cornell University, Yale University, Princeton University, University of North Carolina, University of Texas, Rensselaer Polytechnic Institute
Canada	85	5	University of Toronto, McGill University, University of Calgary, University of British Columbia, University of Alberta
Australia	96	7	University of Adelaide, University of Melbourne, Australian National University, Deakin University, University of New South Wales, University of Queensland, University of Sydney
Germany	103	10	Johannes Gutenberg University Mainz, Technical University of Munich, Max Planck Institute for Plasma Physics, Technical University of Dortmund, Heidelberg University, Ludwig Maximilian University of Munich, Karlsruhe Institute of Technology, University of Stuttgart, TU Dresden, RWTH Aachen University
Netherlands	83	7	University of Groningen, Delft University of Technology, Utrecht University, Eindhoven University of Technology, Netherlands Forensic Institute, University of Amsterdam, University of Twente
Switzerland	93	4	ETH Zurich, University of Geneva, Ecole Polytechnique Federale de Lausanne, Paul Scherrer Institute,
Singapore	87	4	Singapore Institute of Technology, Nanyang Technological University, Singapore University of Technology and

			Design, National University of Singapore
Japan	117	5	University of Tokyo, Kyushu University, Tohoku University, Kyoto University, Tokyo Institute of Technology
China & Hong Kong	126	7	Hong Kong University of Science & Technology, University of Hong Kong, Tsinghua University, Peking University, Fudan University, Tianjin University, Nanjing University
10	950	71	TOTAL

1.3) Statistical analysis

Unpaired t-test and one-way analysis of variance (ANOVA) were performed using GraphPad Prism 7 software at a significant level $\alpha = 0.05$. Correlations were considered statistically significant at a 95% confidence interval ($p < 0.05$).

Table S2. One way ANOVA parameters for the score of critical thinking. White background coloured numbers indicate the mean score for each countries; other values represent the adjusted p-values. Grey background indicates that the difference is statistically not significant ($p > 0.05$), while red background shows differences that are statistically significant ($p < 0.05$)

AUS	8.78	AUS										
CAN	8.55	>0.9999	CAN									
JPN	8.89	>0.9999	0.9971	JPN								
GER	9.02	0.9998	0.9687	>0.9999	GER							
USA	9.04	>0.9999	0.9886	>0.9999	>0.9999	USA						
UK	8.76	>0.9999	>0.9999	>0.9999	0.9999	>0.9999	UK					
SUI	9.08	0.9992	0.9548	>0.9999	>0.9999	>0.9999	0.9995	SUI				
CHN&HK	8.46	0.9962	>0.9999	0.9529	0.8030	0.9330	0.9993	0.7855	CHN&HK			
NED	9.02	0.9998	0.9754	>0.9999	>0.9999	>0.9999	0.9999	>0.9999	0.8462	NED		
SGP	9.00	>0.9999	0.9903	>0.9999	>0.9999	>0.9999	>0.9999	>0.9999	0.9300	>0.9999	SGP	
All	8.94	>0.9999	0.9587	>0.9999	>0.9999	>0.9999	>0.9999	>0.9999	0.5943	>0.9999	>0.9999	

Table S3. One way ANOVA parameters for the score of journal style writing. White background coloured numbers indicate the mean score for each countries; other values represent the adjusted p -values. Grey background indicates that the difference is statistically not significant ($p > 0.05$), while red background shows differences that are statistically significant ($p < 0.05$)

AUS	8.25	AUS										
CAN	7.89	0.8639	CAN									
JPN	8.57	0.8570	0.0445	JPN								
GER	8.89	0.0564	0.0002	0.8535	GER							
USA	8.27	>0.9999	0.9341	0.9699	0.2433	USA						
UK	8.19	>0.9999	0.9848	0.8428	0.2356	0.2757	UK					
SUI	8.53	0.9684	0.1608	>0.9999	0.2130	0.2567	0.2494	SUI				
CHN&HK	8.60	0.7871	0.0297	>0.9999	0.1898	0.2378	0.2299	0.2067	CHN&HK			
NED	8.39	>0.9999	0.5003	0.9976	0.2070	0.2518	0.2443	0.2226	0.2006	NED		
SGP	8.55	0.9690	0.1900	>0.9999	0.2255	0.2671	0.2601	0.2399	0.2195	0.2346	SGP	
All	8.45	0.9734	0.0475	0.9978	0.1473	0.2055	0.1963	0.1686	0.1381	0.1609	0.1840	

Table S4. One way ANOVA parameters for the score of proofreading. White background coloured numbers indicate the mean score for each countries; other values represent the adjusted *p*-values. Grey background indicates that the difference is statistically not significant ($p > 0.05$), while red background shows differences that are statistically significant ($p < 0.05$)

AUS	7.18	AUS										
CAN	8.39	0.0002	CAN									
JPN	7.86	0.1038	0.5520	JPN								
GER	7.87	0.1141	0.6215	>0.9999	GER							
USA	8.57	<0.0001	>0.9999	0.2549	0.3065	USA						
UK	7.56	0.9452	0.1299	0.9880	0.9865	0.0461	UK					
SUI	8.53	<0.0001	>0.9999	0.1610	0.2111	>0.9999	0.0238	SUI				
CHN&HK	7.24	>0.9999	0.0002	0.1276	0.1417	<0.0001	0.9773	<0.0001	CHN&HK			
NED	7.60	0.8461	0.1047	0.9910	0.9898	0.0356	>0.9999	0.0150	0.9148	NED		
SGP	7.77	0.4744	0.5324	>0.9999	>0.9999	0.2554	0.9997	0.1867	0.5677	0.9999	SGP	
All	7.79	0.0281	0.1142	>0.9999	>0.9999	0.0387	0.9937	0.0072	0.0252	0.9953	>0.9999	

Table S5. One way ANOVA parameters for the score of ethical expectations. White background coloured numbers indicate the mean score for each countries; other values represent the adjusted *p*-values. Grey background indicates that the difference is statistically not significant ($p > 0.05$), while red background shows differences that are statistically significant ($p < 0.05$)

AUS	6.21	AUS										
CAN	6.06	>0.9999	CAN									
JPN	5.89	0.9340	0.9998	JPN								
GER	6.02	0.9990	>0.9999	>0.9999	GER							
USA	4.47	<0.0001	<0.0001	<0.0001	<0.0001	USA						
UK	4.11	<0.0001	<0.0001	<0.0001	<0.0001	0.9814	UK					
SUI	5.83	0.9033	0.9988	>0.9999	0.9995	0.0001	<0.0001	SUI				
CHN&HK	6.40	0.9985	0.9394	0.3083	0.7852	<0.0001	<0.0001	0.3303	CHN&HK			
NED	5.83	0.8900	0.9985	>0.9999	0.9994	<0.0001	<0.0001	>0.9999	0.2941	NED		
SGP	6.10	>0.9999	>0.9999	0.9991	>0.9999	<0.0001	<0.0001	0.9963	0.9755	0.9957	SGP	
All	5.82	0.4592	0.9821	>0.9999	0.9837	<0.0001	<0.0001	>0.9999	0.0072	>0.9999	0.9601	

Table S10. One way ANOVA parameters for educational value of peer review for skills a) Critical Thinking; b) Journal-Style Writing; c) Proofreading; d) Ethical Expectations; e) Working to Deadlines; f) Planning; g) Experimental Procedure; and h) Shaping Research. White background coloured numbers indicate the mean value for all countries; other values represent the adjusted *p*-values. Grey background indicates that the difference is statistically not significant (*p* > 0.05), while red background shows differences that are statistically significant (*p* < 0.05)

a)	8.84	a)						
b)	8.45	0.0001	b)					
c)	7.79	<0.0001	<0.0001	c)				
d)	5.82	<0.0001	<0.0001	<0.0001	d)			
e)	5.80	<0.0001	<0.0001	<0.0001	>0.9999	e)		
f)	5.03	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	f)	
g)	4.19	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	g)
h)	6.40	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Table S11. Unpaired *t*-test parameters of the educational value of peer review for responses given by academics and ECRs.

<i>Skills</i>	<i>t value</i>	<i>Degree of freedom</i>	<i>Two-tailed p value</i>	<i>Mean ± standard deviation of academic responses</i>	<i>Mean ± standard deviation of ECRs responses</i>
Critical Thinking	16.57	189	<0.0001	8.842 ± 0.042	6.838 ± 0.114
Journal-Style Writing	14.4	206.2	<0.0001	8.445 ± 0.049	6.669 ± 0.113
Proofreading	10.27	218.8	<0.0001	7.788 ± 0.058	6.405 ± 0.122
Ethical Expectations	0.4872	229	0.6266	5.824 ± 0.057	5.885 ± 0.112
Working to Deadlines	4.436	235.8	<0.0001	5.804 ± 0.070	5.135 ± 0.133
Planning	2.248	222.9	0.0256	5.031 ± 0.063	5.351 ± 0.128
Experimental Procedure	3.454	194	0.0007	4.192 ± 0.059	3.628 ± 0.152
Shaping Research	0.7141	236	0.4758	2.308 ± 0.086	2.176 ± 0.165

2) Academic survey

2.1) How many peer review invitations do you typically accept in a one-month period?

This question was selected to gauge the quantity of reviews performed by academics within a given time frame. The number of peer reviews accepted per month and per country are displayed in Figure S1. These plots show how many individuals report accepting each number of peer review invitations. The plots from UK, USA, Canada, Switzerland, Netherlands, Germany, and Australia show similar distributions, typically showing a peak between the values 2 and 3. The mean number of accepted peer reviews per month for these countries were 3.18, 3.31, 2.88, 2.96, 2.69, 2.68, and 3.42, respectively. China & Hong Kong, Singapore, and Japan had more responses of 7-10+ than other countries. This caused a shift in the distribution of responses to higher values of accepted peer reviews per month. This is also reflected by a higher mean number of accepted reviews per month for all China & Hong Kong (4.86), Singapore (3.92), and Japan (3.89).

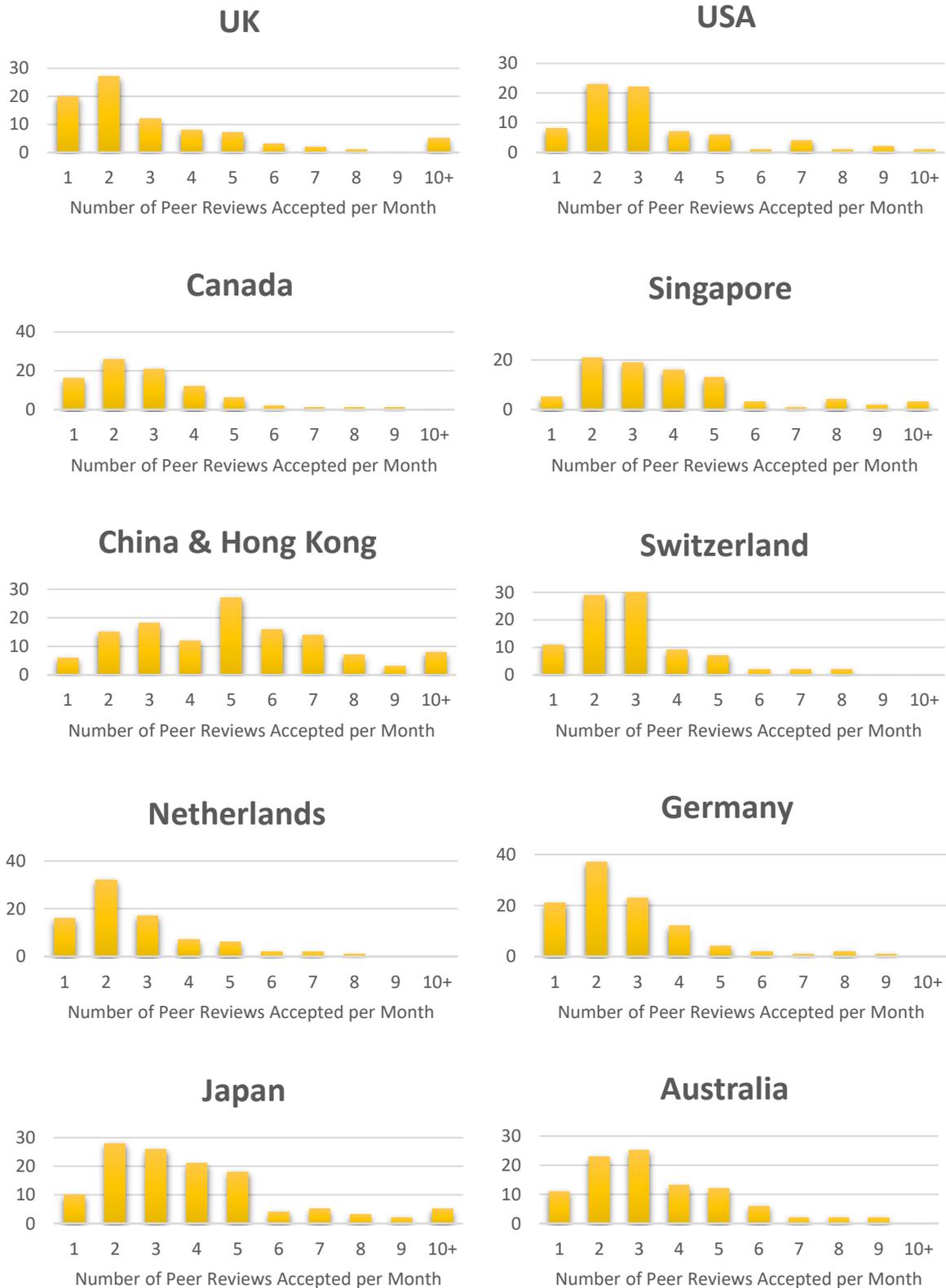


Figure S1. Number of individual responses (vertical axis) from academics in each country when asked ‘How many peer reviews do you typically accept in a one-month period?’

2.2) What is your motivation for offering PGR students under your supervision the opportunity to peer review a manuscript?

This question and the answer options were selected to determine the primary reasons why an academic supervisor would offer peer review opportunities to ECRs. The academic was asked to rank the five options on a scale of 1-5, with 1 being the most relevant reason and 5 being the least relevant. The reasons for ECR involvement were split into either ‘work-efficiency’ or ‘teaching’ options; see page S2 for the list of survey questions and possible responses. Options (a) and (b) were deemed to be work-efficiency oriented, i.e., the academics involved ECRs to expedite the review process or to alleviate workload. Options (c), (d), and (e) were teaching oriented; the academics used peer review mainly as an educational tool to develop skills of ECRs or to expose them to new materials and exercises. The average rankings by country for each option FOR the involvement of ECRs are displayed in Table S12. The primary reason given by academics for offering peer reviews to ECRs was to ‘familiarise them with the publication process’. This was ranked as the highest reason for 9/10 surveyed countries. USA was the only country that did not rank this reason as the highest; ‘alleviating workload’ received the highest average ranking from academics in USA. The lowest ranked reason for the involvement of ECRs was more diverse; 5/10 countries selected ‘to complete the review within a time deadline’, 4/10 selected ‘to increase their expertise in a given field’, and 1/10 selected ‘to alleviate workload’. The value and current use of peer review as an educational tool is supported by the 9/10 countries ranking a teaching-oriented reason as their primary motivation for involving ECRs in peer review.

Figure S2 shows the total percentage of academics who offered peer review opportunities to ECRs, and Figure S3 (and Figure 4 in the main text) compares the number of peer review invitations accepted each month by academics to whether the motivation for involving ECRs was workload or teaching oriented. If a given survey participant replied with a ranking of 1 or 2 out of 5 (to options given for Question 4 in academic survey), these were taken to be their main reasons for including ECRs in peer review. As can be seen in Figure S2 (and Figure 4), an extremely high percentage of academics that reported accepting 4+ peer reviews per month also reported offering peer review to ECRs. Of these, a notably higher percentage of respondents gave a work-efficiency reason for involving ECRs. Conversely, academics who accepted 1-3 manuscripts in a one-month period typically offered fewer peer review opportunities to ECRs, with the primary reasons for offering peer review being almost exclusively teaching oriented.

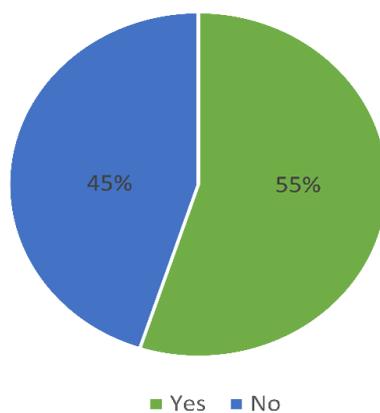


Figure S2. Percentage of all academic respondents answering ‘Yes’ or ‘No’ when asked ‘Have you offered a PGR student under your supervision the opportunity to peer review a manuscript?’

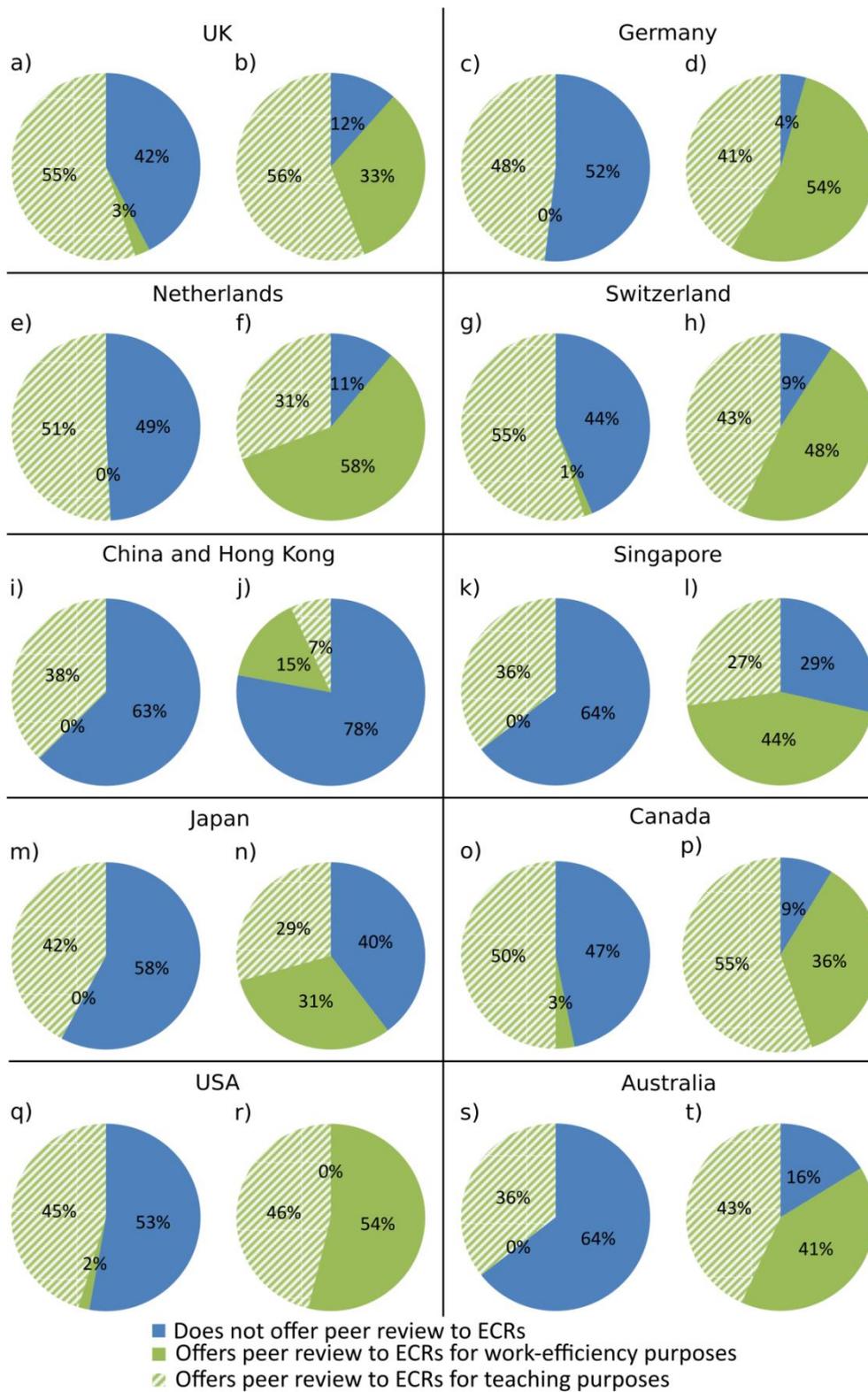


Figure S3. Percentages of academic respondents offering peer review to ECRs. a), c), e), g), i), k), m), o), q), s) show data where 1-3 manuscripts are accepted for peer review per month. b), d), f), h), j), l), n), p), r), t) show data where 4+ manuscripts are accepted for peer review per month. a), b) provide data for UK; c), d) for Germany; e), f) for Netherlands; g), h) for Switzerland; i), j) for China & Hong Kong; k), l), for Singapore; m), n) for Japan; o), p) for Canada; q), r) for USA; and s), t) for Australia.

2.3) What is your motivation for NOT offering PGR students under your supervision the opportunity to peer review a manuscript?

Despite the study focusing on the inclusion of ECRs in peer review, it was necessary to consider reasons why academics may feel reluctant to offer peer review opportunities. Survey participants were asked to rank the answer options on a scale of 1-5, with 1 being the most relevant reason and 5 being the least relevant. The average rankings by country for each option for NOT involving ECRs in peer review are displayed in Table S13. Similar to Table S12, a large majority agrees on the main reason for not involving ECRs in peer review. The deciding factor for not offering peer review to ECRs in 8/10 countries was ‘due to their lack of experience with the publication process’. The primary reason for not offering peer review in 2/10 countries (China & Hong Kong and Singapore) was that ‘you would rather them focus on their research’. The lowest ranked reason in 8/10 countries was ‘you do not feel that peer review is a beneficial practice for PGR students’. However, this reason also received the lowest number of responses for each country, with no country giving more than ten responses. The lowest ranked reason for not offering peer review to ECRs in 2/10 countries (UK and USA) was ‘you do not have time to teach them about the review process’. These results indicate that academics do not offer peer review largely due to worries about the inexperience of ECR peer reviewers rather than academics considering peer review an ineffective educational tool.

Table S12. Average rankings given by academics in each country when asked to rank the reasons for involving ECRs in peer reviews, with 1 being the most relevant and 5 being the least relevant. Green entries indicate the highest ranked option and red the lowest ranked option for each country. a) To alleviate your workload; b) To help complete the review within a time deadline; c) To increase the students’ expertise in a relevant field; d) To familiarise the student with the publication process; and e) To familiarise the student with journal-style writing.

	<i>a)</i>	<i>b)</i>	<i>c)</i>	<i>d)</i>	<i>e)</i>
UK	2.44	4.37	2.88	1.57	2.61
USA	1.81	3.44	3.67	1.82	2.28
Canada	2.61	3.58	2.86	1.65	2.29
Australia	2.32	3.42	3.04	1.65	2.40
Germany	3.18	2.95	2.78	1.56	2.18
Netherlands	2.77	3.32	3.00	1.63	2.24
Switzerland	2.77	3.23	3.21	1.70	2.13
Singapore	1.93	2.46	2.86	1.64	2.70
Japan	2.64	2.57	2.67	1.72	2.05
China & Hong Kong	1.53	2.56	3.28	1.81	2.34
TOTAL AVERAGE RANKING	2.40 (3)	3.19 (5)	3.03 (4)	1.68 (1)	2.32 (2)

Table S13. Average rankings given by academics in each country when asked to rank the reasons for NOT involving ECRs in peer reviews, with 1 being the most relevant and 5 being the least relevant. Green entries indicate the highest ranked option and red the lowest ranked option for each country. a) You would rather they focus on their research; b) Due to their lack of experience with the publication process; c) You do not feel that peer review is a beneficial practice for ECRs; d) You do not have time to teach them about the review process; and e) You do not have time to give feedback on their review.

	<i>a)</i>	<i>b)</i>	<i>c)</i>	<i>d)</i>	<i>e)</i>
UK	1.61	1.44	3.00	3.50	2.83
USA	2.05	1.04	3.00	3.83	3.50
Canada	1.43	1.42	5.00	2.85	3.14
Australia	1.61	1.37	5.00	3.09	3.78
Germany	1.88	1.43	5.00	3.04	3.08
Netherlands	2.12	1.29	5.00	2.95	2.95
Switzerland	1.89	1.33	4.00	3.17	3.16
Singapore	1.43	1.46	4.00	3.05	3.13
Japan	1.67	1.50	5.00	2.95	2.57
China & Hong Kong	1.37	1.77	5.00	2.90	3.24
TOTAL AVERAGE RANKING	1.71 (2)	1.41 (1)	4.40 (5)	3.13 (3)	3.14 (4)

2.4) Educational value of peer review – Academic breakdown by country

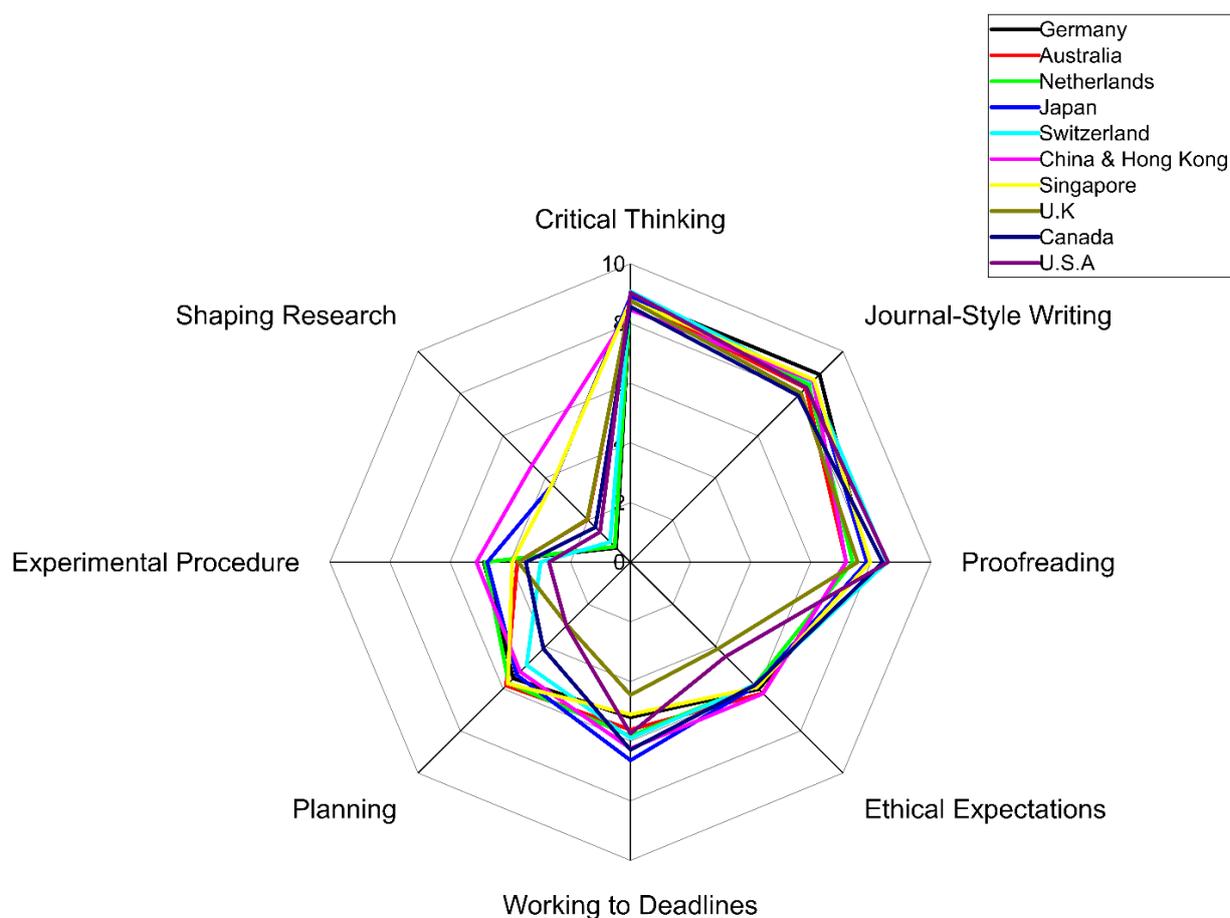


Figure S4. Radar chart displaying the average educational value of peer review towards selected skills for each of the surveyed countries.

Figure S4 displays radar charts for each country showing the mean educational value of peer review for each of the skills. The discrete mean values displayed in this chart are included in Table S14. All ‘total mean scores’ displayed in Table S14 correspond to the values depicted in the radar chart in the main text (Figure 5). The distribution of scores for each skill are represented statistically by the box and whisker plots given in Figure S5.

There appears to be mutual agreement among academics in all ten countries regarding the benefits of peer review in terms of critical thinking, journal-style writing, and proofreading skills. For critical thinking, the difference between the lowest mean educational value score (8.46 for China & Hong Kong) and the highest score (9.08 for Switzerland) was statistically not significant (Table S2) with a range of 0.62. This range increased slightly for journal-style writing (1.00) and proofreading (1.40) between Canada and Germany and Switzerland and China & Hong Kong, respectively. Although the difference in mean values between the countries above was statistically significant, the variance between other countries was generally not significant. (Table S3-4) Thus, the educational value of peer review in terms of these skills was largely confirmed by academics. For the remaining skills, the larger range and discrepancy of scores indicated by the plots reflect divergent views on the merit of peer review as an educational tool in different countries. This is most evident when examining the data and box plot for the shaping research skill, which easily had the highest distribution of scores among countries. For this skill, the educational value of peer review was scored as low as 0.67 (Germany) and as high as 4.62 (China & Hong Kong).

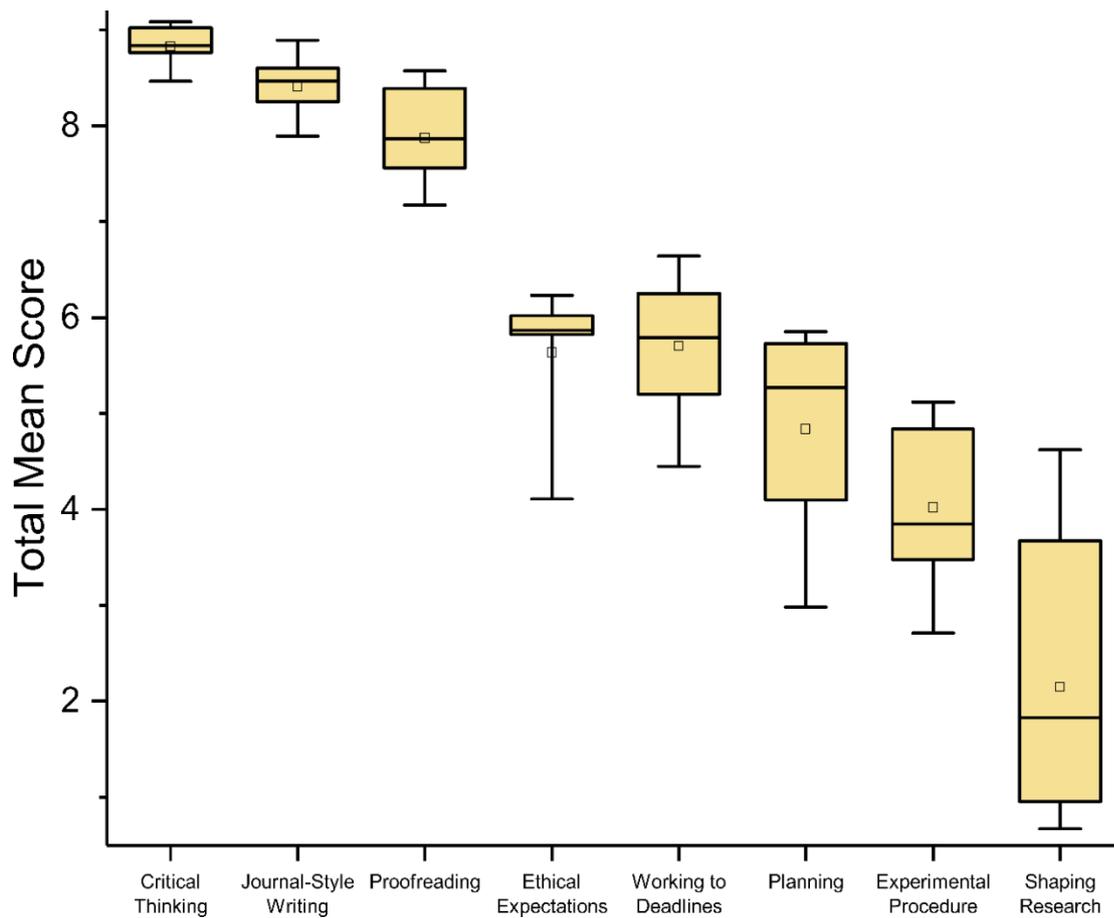


Figure S5. Box and whisker plots for mean scores of educational value of peer review for each skill, from the data displayed in Table S14. (Whiskers – Top (Upper Range), Bottom (Lower Range), Box – Top (Upper Quartile), Bottom (Lower Quartile), Median – Solid Line in Box, Mean – Square Marker in Box).

Table S14. Mean scores from all countries for educational value of peer review as given in Figure S4 for the skills a) Critical Thinking; b) Journal-Style Writing; c) Proofreading; d) Ethical Expectations; e) Working to Deadlines; f) Planning; g) Experimental Procedure; and h) Shaping Research.

	<i>a)</i>	<i>b)</i>	<i>c)</i>	<i>d)</i>	<i>e)</i>	<i>f)</i>	<i>g)</i>	<i>h)</i>
UK	8.76	8.02	7.56	4.11	4.45	2.98	3.73	2.03
USA	9.04	8.27	8.57	4.47	5.75	3.02	2.71	1.43
Canada	8.56	7.89	8.39	5.84	6.29	4.10	3.48	1.65
Australia	8.78	8.25	7.18	6.21	5.62	5.85	3.76	2.01
Germany	8.92	8.89	7.87	6.02	5.20	5.51	4.87	0.67
Netherlands	9.02	8.39	7.59	5.83	5.83	5.73	4.84	0.74
Switzerland	9.08	8.53	8.53	5.82	5.9	4.88	2.99	0.96
Singapore	8.77	8.64	7.98	5.94	5.1	5.76	3.94	3.69
Japan	8.89	8.58	7.86	5.89	6.64	5.35	4.76	3.67
China & Hong Kong	8.46	8.60	7.17	6.23	6.25	5.19	5.12	4.62
<i>Total Mean Score</i>	8.84	8.45	7.79	5.82	5.80	5.03	4.19	2.31

Clustering of the educational value scores by country was investigated to highlight any existing patterns. Sammon's nonlinear mapping procedure was applied on the complete group of individual educational value responses (8-dimensional vectors). The obtained two-dimensional map is presented in Figure S6. Slight grouping of the responses from Asian universities may be observed at positive 1st dimension values. However, no distinct clusters can be seen which suggests that the educational value scores given by the respondents were mostly influenced by individual perception rather than cultural consensus.

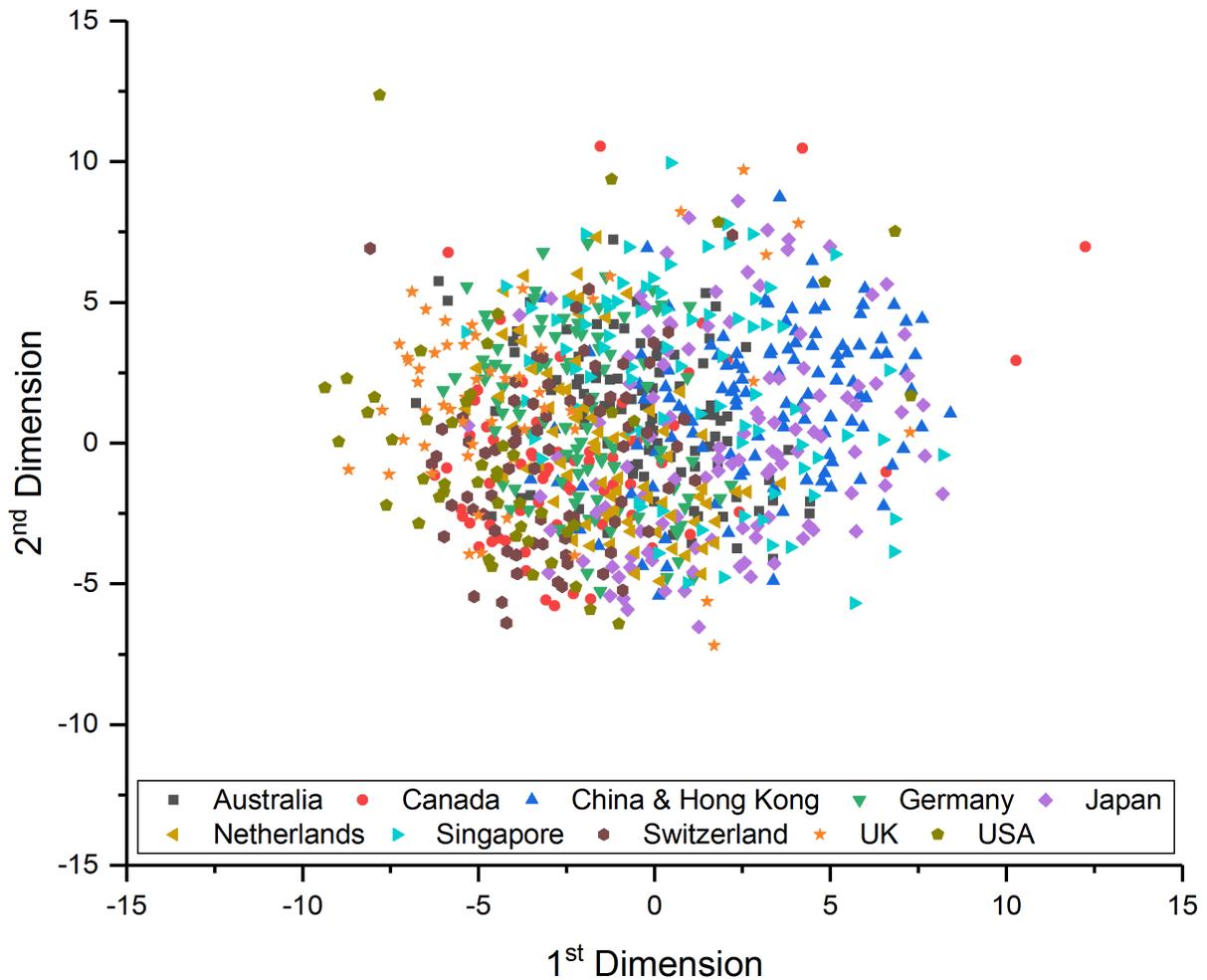


Figure S6 Sammon map of educational value responses. Each point shown represents an 8-dimensional pattern projected into two dimensions by the Sammon method.



Figure S7. Individual responses from all ten countries when academics were asked to score the educational value of peer review for each of the given skills on a scale of 0-10).

3) ECR Survey

3.1) Do you get invited to peer review manuscripts for academic journals?

A total of 253 responses were received for the ECR survey, with 148/253 (58%) ECRs stating that they had received offers to assist with peer review and 105/253 (42%) stating that they had not. These values are displayed as percentages in Figure S8. These percentages closely match the total percentage of academics who offered peer review to ECRs (Figure S2), as determined by the academic survey (Yes – 55%, No – 45%). This reinforces the possibility of the greater involvement of ECRs in peer review.

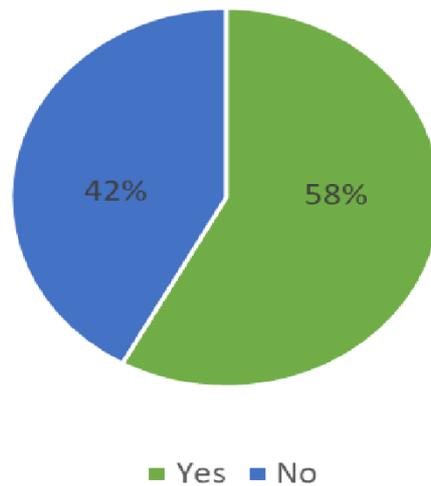


Figure S8. Percentage of all ECR respondents answering ‘Yes’ or ‘No’ when asked ‘Do you get invited to peer review manuscripts for academic journals?’

3.2) Number of manuscripts reviewed per year by ECRs (if invited to peer review).

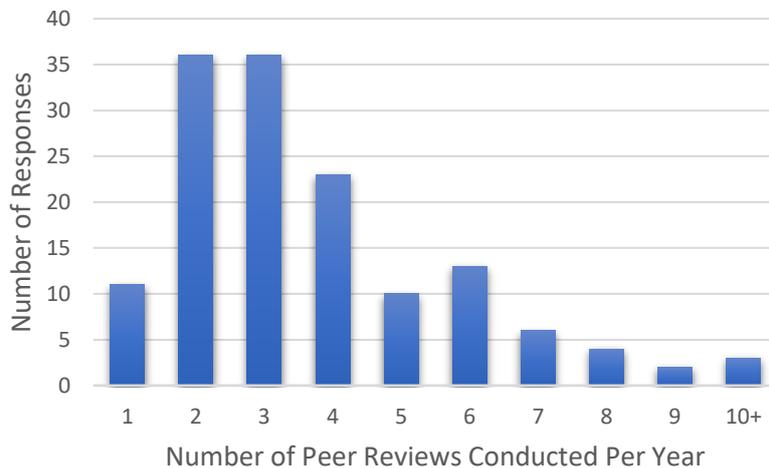


Figure S9. Number of individual responses when ECRs were asked ‘Approximately how many manuscripts do you review per year?’

The 144 responses to this question reported an average of 3.72 manuscript reviews conducted each year. The student survey question differed from the academic survey, which asked academics to state how many peer review invitations were accepted ‘per month’ due to the high number of peer reviews that are conducted by academics.

3.3) If your supervisor invited you to assist with peer reviewing academic manuscripts, what do you think is their motivation for inviting you to assist the review?

Echoing the academic survey, ECRs were asked to rank the reasons why their supervisor may have asked them to assist their reviews. The answer options were the same for both the academic and the ECR surveys. The average rankings given by ECRs are displayed in Table S15.

Table S15. Average rankings given by ECRs when asked to rank the reasons why their supervisor involved them in peer review. a) To alleviate their workload; b) To help complete the review within a time deadline; c) To increase the students' expertise in a relevant field; d) To familiarise the student with the publication process; and e) To familiarise the student with journal-style writing.

	<i>a)</i>	<i>b)</i>	<i>c)</i>	<i>d)</i>	<i>e)</i>
<i>ECR AVERAGE RANKING</i>	3.21 (3)	3.34 (5)	3.28 (4)	1.65 (1)	1.88 (2)

Overall, the rankings matched between the ECR and academic surveys. 'To familiarise the student with the publication process' was the most relevant reason for the involvement of ECRs in both cases, and 'to help complete the review within a time deadline' was the least relevant reason. This indicates that both groups saw the educational benefits of involving ECRs in peer review.

3.4) If your supervisor does not involve you in the peer review process, rank the main reasons for NOT inviting PGR students to peer review manuscripts.

From the survey answer options, 'Don't know why they do not invite students' was ranked as the most relevant reason. This indicates that when no peer review is offered, it is generally not discussed by ECRs and supervisors.

3.5) Educational value of peer review – ECR vs. academic responses

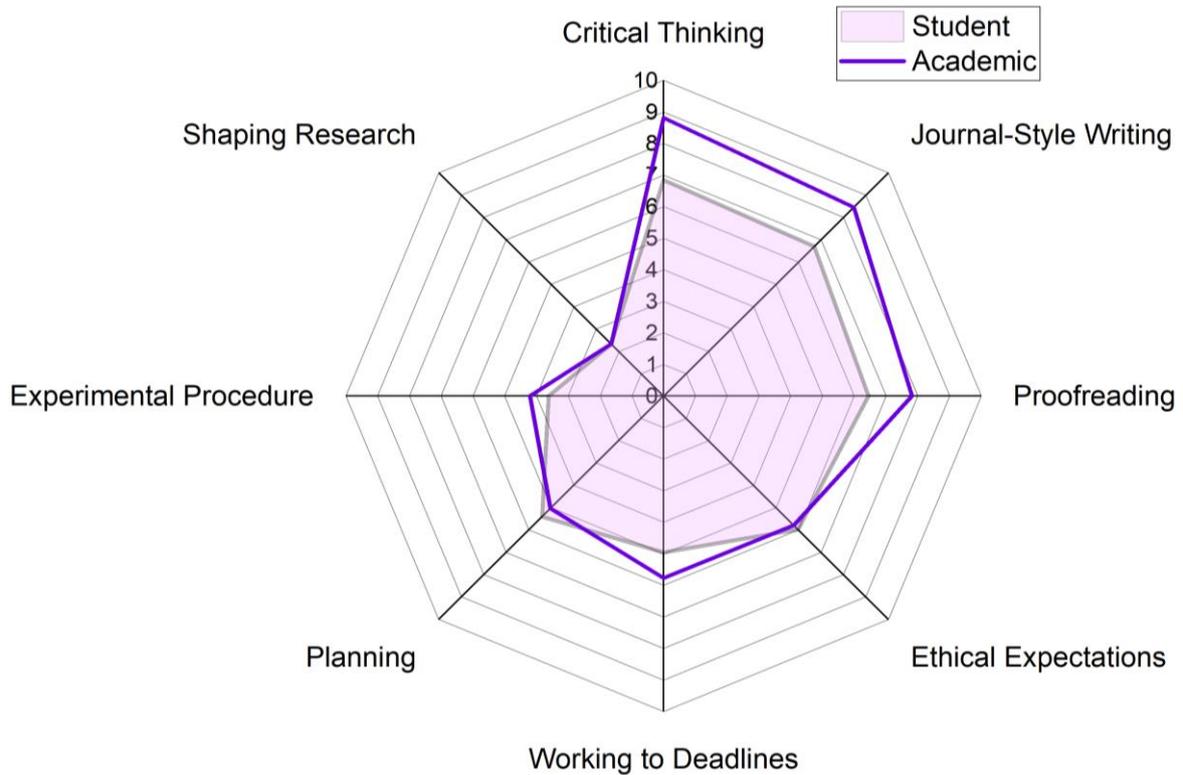


Figure S10. Radar chart displaying the average ratings from the academic and student surveys for the educational value of peer review for selected skills.

Figure S10 shows a direct comparison between the mean educational value of peer review for all of the selected skills as rated by the academics and ECRs surveyed. Both academics and ECRs scored the skills that received the most educational value from performing peer reviews in the order of critical thinking > journal-style writing > proofreading. Ethical expectations and planning were the only skills that received higher scores from ECRs than academics. Although, the difference in ethical expectations is not significant, the change in planning is statistically significant (Table S10). The charts show that academics and ECRs generally agree on which skills are most influenced by peer review.

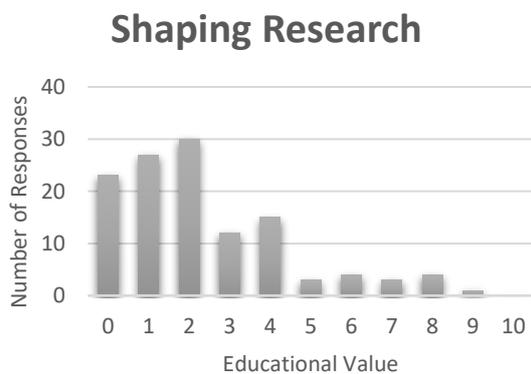
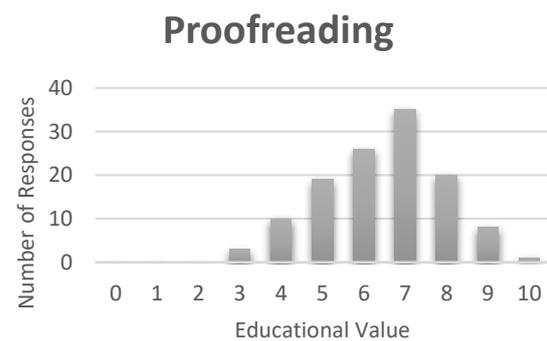
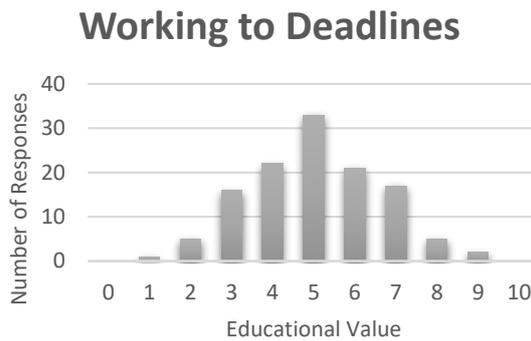
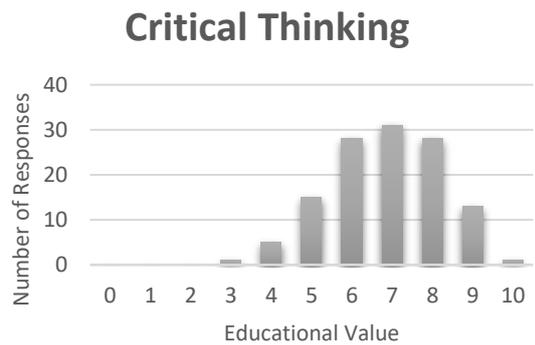
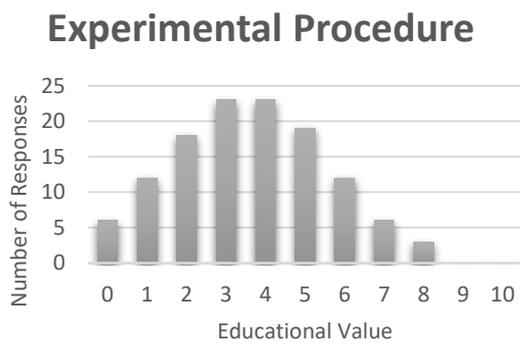
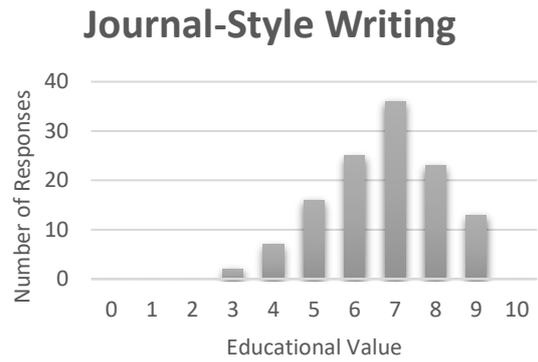


Figure S11. Complete breakdown of individual responses when ECRs were asked to score the educational value of peer review to each of the given skills on a scale of 0-10.

3.6) If your supervisor involves you in peer reviewing academic manuscripts, are you aware if the supervisor sought permission from the Editor to involve you in the review?

The ECR survey returned 148 responses to the above question. Of these, 58 (39%) stated that they were aware if their supervisor had sought permission from the Editor, and 90 (61%) stated that that they were unaware if permission had been sought.

3.7) If your supervisor involves you in peer reviewing academic manuscripts, were you given detailed instructions about confidentiality?

Again, 148 responses to this question were received from the ECR survey. Somewhat revealingly, 98 (66%) of ECR respondents reported that they were not given detailed instructions regarding confidentiality; only 50 (34%) said that they were given detailed instructions. This indicates room for improvement regarding discussions between ECRs and academics about confidentiality and the ethical aspects of peer review.

3.8) If your supervisor involves you in peer reviewing academic manuscripts, do you get feedback and constructive comments on your review from your supervisor?

The ECR survey returned 143 responses to the above question. Interestingly, only 44 (31%) of the ECR respondents who had performed a peer review previously stated that they received constructive feedback and comments on their reviews. No feedback was reported by 99 (69%) of the respondents. Again, this indicates for improvement in the communication between ECRs and academics.

If ECRs are given the opportunity to conduct multiple peer reviews, receiving feedback and comments on each, then ECRs will be able to identify strengths and weaknesses within their own work. Thus, both their reviewing skills and their general research skills will improve.

4) PEER Guidelines (Protocol for ECRs to Effectively Review)

The PEER guidelines in this section provide useful considerations for ECRs when conducting initial manuscript reviews. The guidelines have been constructed based on the skills referred to throughout the manuscript, with important questions that one must consider when evaluating these aspects of a manuscript. The guidelines offer hints as to what experienced reviewers look out for when appraising scientific manuscripts and also self-evaluations which are just as pertinent when conducting a peer review.

1. Critical Thinking

Are authors drawing valid conclusions based only on the results presented?

Have the author(s) clearly established the novelty/originality/impact of their work?

Does the author acknowledge any results that fall outside of a particular trend?

Can the author properly justify the success/failure of their research?

2. Journal-Style Writing

Have authors communicated their research in a way that can be understood by a wider audience?

Are all results (data, tables, graphs) presented so that they are 'information rich*'? *Maximising output of information in a concise and easy-to-read manner.

Does the author duplicate any results which may be removed from the manuscript? (Different figures presenting similar information, repetition of text etc)

Are all figures and tables legible?

Is the manuscript properly structured, with clear sections and headings?

Are important figures and information properly highlighted in the manuscript?

Is the manuscript easy to read and follow? (i.e. no scattered information, reported in chronological order where appropriate).

3. Proofreading

Does the manuscript contain any spelling mistakes or grammatical errors?

Are all figures, tables, sections and sub-sections labelled correctly?

Are all abbreviations defined previously in the text?

4. Ethical Expectations

If not novel, does the author properly cite and reference all previous works and ideas they refer to in the manuscript?

Are you familiar with the guidelines for a given journal with regards to ethical peer reviewing and ethical publishing? (If no, details found on journal website)

Have you discussed in detail the confidentiality of the review with your academic supervisor? (Single blind, double-blind, open)

5. Working to Deadlines

Are you aware of the deadline by which date the review must be completed?

Do you feel that you can provide a comprehensive review (usually at least 2 read-throughs) before the agreed deadline?

Are you confident that you can conduct the review without detriment to the progress of your own research?

Are you aware of how a delayed review could affect the time taken for a manuscript to be published?

6. Planning

Have you planned the structure, language and content you will use for your responses to editors when conducting a review?

Have you allocated time within your daily routine for research into literature and to compose the responses for a peer review?

7. Experimental Procedure

Does the author(s) outline a clear, succinct and reproducible experimental methodology?

If appropriate, does the author state materials, quantities used and supplier/manufacturer?

If appropriate, does the author provide descriptions of all instrumentation used?

If the author follows a literature method, do they cite the original/pioneering work for this experimental route?

Is all experimental data gathered reliably and are all errors and error calculations clearly stated?

8. Shaping Research

Are you aware that the details read in an unpublished manuscript MUST NOT be used as inspiration for your personal research until it is published?

Are you aware that your review will influence the editor's decision for publication of a work in a peer-reviewed journal?

Are you aware of novel, impactful and relevant research themes within the field in which you are currently reviewing?

Are you aware of the standard your personal research must reflect to warrant publication in a peer-reviewed journal?