The Benefits of and Motivations Behind Large-Team Coordination in Psychology - Supplementary Materials

Sajedeh Rasti, Krist Vaesen, and Daniel Lakens

Industrial Engineering and Innovation Sciences, Eindhoven University of Technology

Author Note

Sajedeh Rasti https://orcid.org/0009-0007-3416-7692

Krist Vaesen https://orcid.org/0000-0002-7496-7463

Daniel Lakens https://orcid.org/0000-0002-8393-5316

Correspondence concerning this article should be addressed to Sajedeh Rasti, Industrial Engineering and Innovation Sciences, Eindhoven University of Technology, Den Dolech 2, 5600 MB, Eindhoven, Eindhoven, Email: S.Rasti@tue.nl

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Data Preprocessing

After retrieving data from the OpenAlex snapshot, duplicated records were removed in two stages. We started with duplicates in OpenAlex identifiers (oa_id) and then identified the remaining duplicates based on a combination of DOI, publication date, journal name, volume, issue, and page number.

Next, we removed the records outside of the time period January 1, 1975, and September 15, 2024. We only retained records classified as journal articles and written in English. To further ensure language consistency, we removed records with non-ASCII characters in their title.

To calculate the number of authors per article, we counted unique OpenAlex author identifiers associated with each record. We also calculated a time-difference variable to later compute date-corrected citation counts. This variable was calculated as the number of days between the publication date and the date of downloading the snapshot (September 14, 2024), with same-day publications set to a minimum value of one day to avoid zero values.

To focus the dataset on psychology-related research, automated filtering steps were applied based on article titles, journal names, and ISSNs.

After removing obvious non-article content (i.e., acknowledgement, reviewer list, and achievement), we manually inspected 800 randomly selected records in four installments of 200. For each installment, titles and journal names were reviewed to identify irrelevant content. Identified keywords were removed from the dataset before proceeding to the next installment. The final list of keywords used for cleaning is provided below.

Table 1

Keywords used for the first round

Section	Keywords
Title	Essay; Symposium; Table of Contents; Proceedings; Annual Meeting; Blockchain; Bug; Temporal Network; Handbook; Conference; Control System; Poetry; Dance; Update on; Machine Learning; Nuclear; Physics; Portfolio; Solar Power; Epilogue; Opening; Book Review; Commentary; Reporting Guideline; Editorial; Nursing; Publication Information; Sibling Designs; Airfoil; Meeting and Workshops; Correction to
Journal name	History; Software; Acoustics; Surgery; Tourism; Chemistry; Robotics; Physical;Entrepreneurial Business; Computer Science; Environmental; Pharmacology; Signal Processing; Electronic; Nutrition; Engineering; Anthropology; Energy; Safety Progress; Mathematics; Philosophy; Nursing; Pediatrics; Information Technology; Physics; Medicine; Law; Criminology; Immunology; Marketing; Finance; Transportation; Operations Research; Medical Ethics; Biology
ISSN	1073-1911; 0022-0418; 1356-5028; 1440-7833; 0894-069X; 0013-7545; 1940-9052; 1063-5157; 0042-8469; 1327-9556; 1660-9336; 0127-9696; 1470-5427

When we manually read the abstacts for the qualitative section, we added the following keywords for article titles and journal names to remove remaining non-relevant content. Case-sensitive filters were applied for identified acronyms that were associated with non-psychology domains (i.e, HIV, COPD, serum, BMI, IPCC). A small number of records were also removed based on explicit OpenAlex identifiers identified during manual screening. We also identified one paper (i.e., https://openalex.org/W1995163329) with incorrect metadata.

Table 2

Keywords used for the second round

Section	Keywords
Title	correction; Book Notes; Day-by Day; Respiratory; Cover-Chewing; daytime napping; immune protection; CSCL System; Poster Session; colonial legacy; Cardiopulmonary; blood disorders; DMD patients; Upper Limb; About the Contributors; acousto-mechanical; grid computing; ventilation; cyberinfrastructure; PRO-TECT; geospatial; interprofessional medication; Phenotypic; artery bypass; Madagascar; metabolomics; aesthetic surg; endometrial; tertiary care; deflagration; Temparature; Temperature; nano-material; Diffusion; Infection; transportation; tuberculosis; Photographic; Vitreoretinopathy; hybrid mixtures; Prophylactic; Abstracts; lightcurves; ape decline; fibrosis; AQUA; primate extinction; particle; ISOCAM; diabetes; Stopwatch; genetics gap; Blood Collection; muscular dystrophy; Symbolic universes; Decarboxylase; ERA Registry; molecular; Flow System; antioxidant; autopsy; Natural gas; OpenModelica; geological; Nanotube; ape extinction; Arthritis; Cardiovascular; genomic epidemiology; Stem Cell; atrophy; debris disk; bioinformatics; Antibodies; aortic; Telepresence; narcolepsy; Traumatic Brain Injury; Hypoferremia; Stroke; oncology; Galaxy; Metabolit; harmonization; versatility; ivory; Ecology; motor disorder; Cardiac pacing; Edible Insects; entomology; gas gauge; endangered species; hepatitis; Sydenham Chorea; Pollinator; dialysis; Biomarkers
Journal name	pac; oncology; APS
OpenAlex identifier	https://openalex.org/W4382936650; https://openalex.org/W4200564330; https://openalex.org/W4286762924; https://openalex.org/W3097713271; https://openalex.org/W1992360116; https://openalex.org/W4312679429; https://openalex.org/W3215287579; https://openalex.org/W3043317701; https://openalex.org/W1967120130; https://openalex.org/W3203418161; https://openalex.org/W4282915658; https://openalex.org/W4391495193; https://openalex.org/W2542228716; https://openalex.org/W3196418672; https://openalex.org/W2026532911; https://openalex.org/W4400112743; https://openalex.org/W1514933037; https://openalex.org/W2055798093; https://openalex.org/W2285173204; https://openalex.org/W4220867049; https://openalex.org/W3159009895; https://openalex.org/W2325257031; https://openalex.org/W2795224003; https://openalex.org/W3205560381; https://openalex.org/W2274190439; https://openalex.org/W2943251031; https://openalex.org/W4388728636; https://openalex.org/W2985950284; https://openalex.org/W2591445343; https://openalex.org/W1995163329

Sensitivity Analyses

This section contains the sensitivity analyses and robustness checks corresponding to each result presented in the manuscript.

Choosing 20 as a threshold for large teams in qualitative analysis

We used Dunn test to compare whether the mean rank of any two groups are different for total citation and second-year citation and used Benjamini-Hochburg adjustment to control for multiple comparisons. We then counted the number of times each author group significantly ($\alpha < 0.05$) had higher (*wins*) and lower (*losses*) mean rank citation than the compared group. Across different group size definitions, we found that the groups with 20 or more authors consistently have more overall score (*wins* - *losses*) than smaller group. We therefore, used 20 as the threshold for large teams for qualitative analysis.

Table 3

Rank ordering groups of authors across different team size definition based on their performance in Dunn test of total citation

Group size of 5	wins	losses	overall
101+	9	0	9
36–40	9	0	9
71–75	9	0	9
26–30	8	0	8
31–35	8	0	8
41–45	8	0	8
61–65	8	0	8
76–80	8	0	8
81–85	8	0	8
21–25	8	3	5
46–50	4	0	4
51–55	3	0	3
56–60	2	0	2
86–90	2	0	2
91–95	2	0	2
66–70	1	0	1
96–100	1	0	1
16–20	7	10	-3
11–15	4	11	-7
5	4	11	-7
6–10	4	11	-7
4	3	15	-12
3	2	17	-15
2	1	21	-20
1	0	24	-24

Group size of 10	wins	losses	overall
76–85	9	0	9
36–45	7	0	7
56–65	7	0	7
66–75	7	0	7
86–95	7	0	7
96+	7	0	7
26–35	7	1	6
46–55	6	1	5
16–25	6	7	-1
5	4	9	-5
6–15	4	9	-5
4	3	11	-8
3	2	12	-10
2	1	13	-12
1	0	14	-14

Group size of 15	wins	losses	overall
101+	7	0	7
36–50	7	0	7
66–80	7	0	7
81–95	7	0	7
51–65	6	0	6
21–35	6	4	2
5	4	6	-2
6–20	4	6	-2
4	3	8	-5
3	2	9	-7
2	1	10	-9
1	0	11	-11

Table 4

Rank ordering groups of authors across different team size definition based on their performance in Dunn test of second-year citation

Group size of 5	wins	losses	overall
101+	14	0	14
71–75	14	0	14
81–85	14	0	14
76–80	11	0	11
36–40	9	0	9
61–65	9	0	9
41–45	8	0	8
51–55	8	0	8
86–90	7	0	7
91–95	7	0	7
26–30	9	3	6
31–35	8	3	5
46–50	6	3	3
96–100	2	0	2
21–25	8	7	1
56–60	5	4	1
66–70	3	4	-1
16–20	7	11	-4
11–15	6	14	-8
6–10	5	16	-11
5	4	18	-14
4	3	19	-16
3	2	21	-19
2	1	23	-22
1	0	24	-24

Group size of 10	wins	losses	overall
76–85	11	0	11
96+	9	0	9
66–75	7	0	7
86–95	7	0	7
36–45	7	1	6
56–65	7	1	6
26–35	7	2	5
46–55	7	2	5
16–25	6	8	-2
6–15	5	9	-4
5	4	10	-6
4	3	11	-8
3	2	12	-10
2	1	13	-12
1	0	14	-14

Group size of 15	wins	losses	overall
101+	8	0	8
81–95	8	0	8
66–80	7	0	7
51–65	6	0	6
36–50	7	2	5
21–35	6	4	2
6–20	5	6	-1
5	4	7	-3
4	3	8	-5
3	2	9	-7
2	1	10	-9
1	0	11	-11

Large-team science is an increasing phenomenon

Regardless of the definition of team size, papers with larger team size have grown dramatically compared to papers with smaller team size.

Figure 1

Growth of large-team papers in groups of five

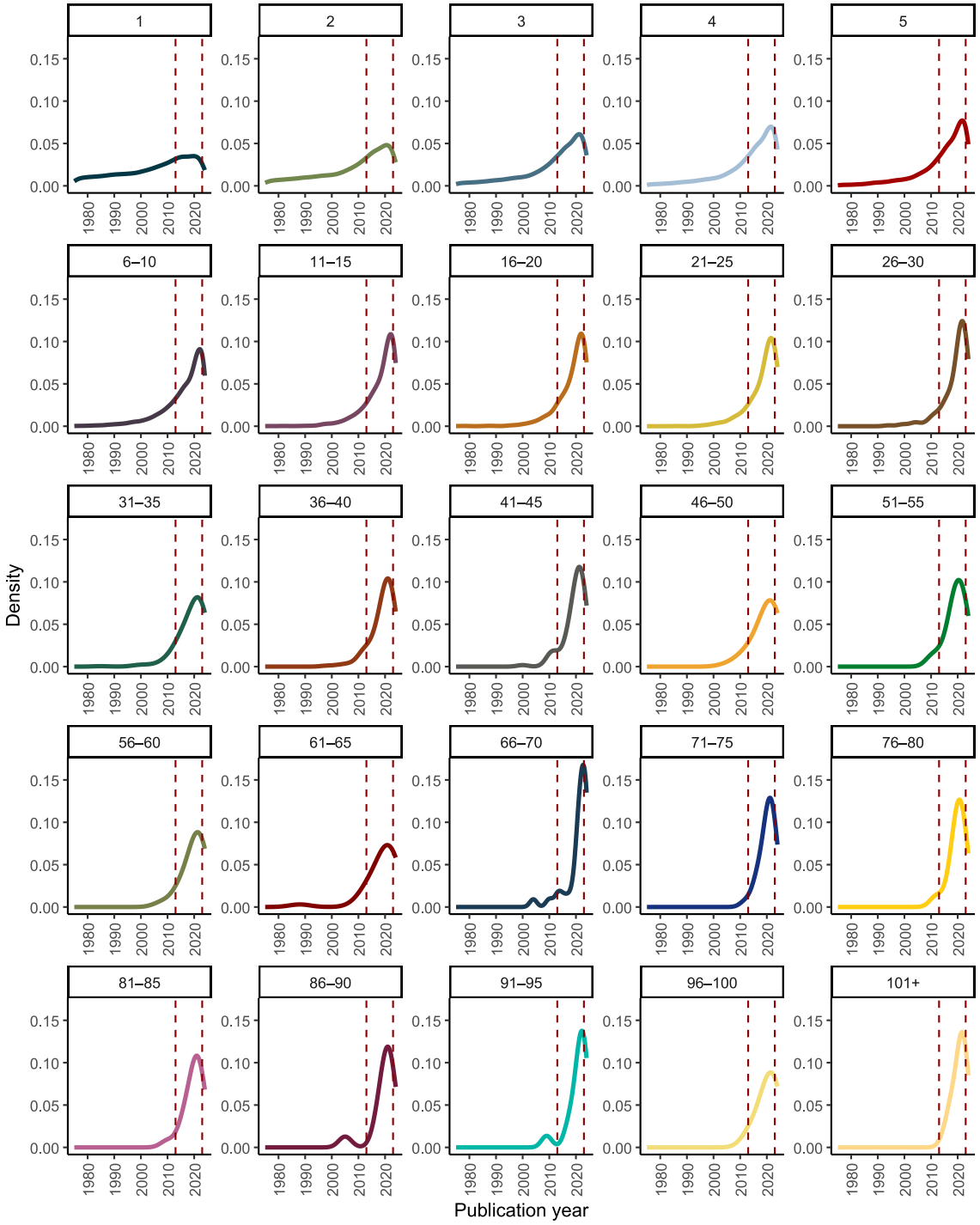
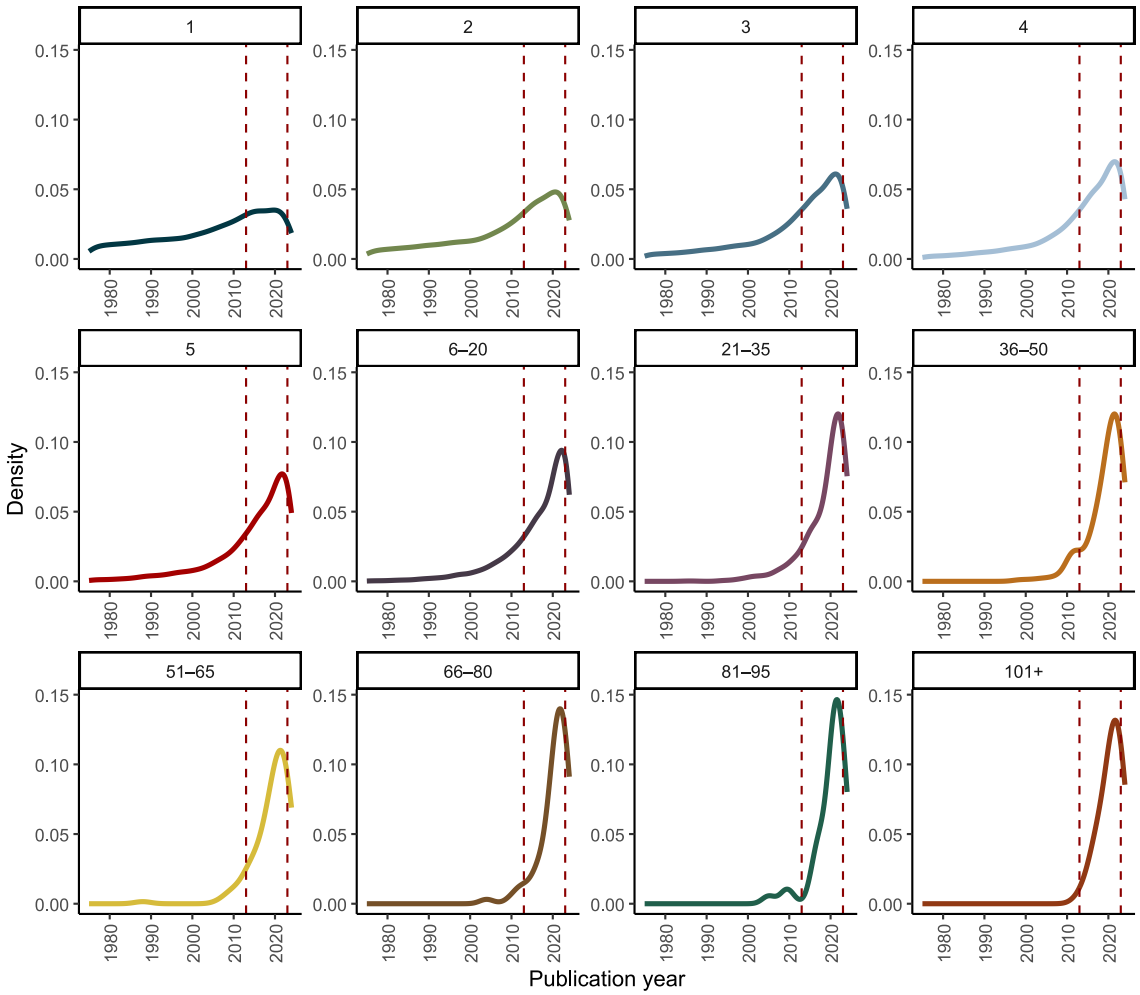


Figure 2

Growth of large-team papers in groups of fifteen



Larger teams receive more citations

Across different measures of citation (i.e., total citation, 2-year-citation, and date-corrected citation) and different definitions of team size, the mean and median for larger teams increase relatively stably until 55 authors and then experience fluctuations.

Figure 3

Team size of five and total citation counts

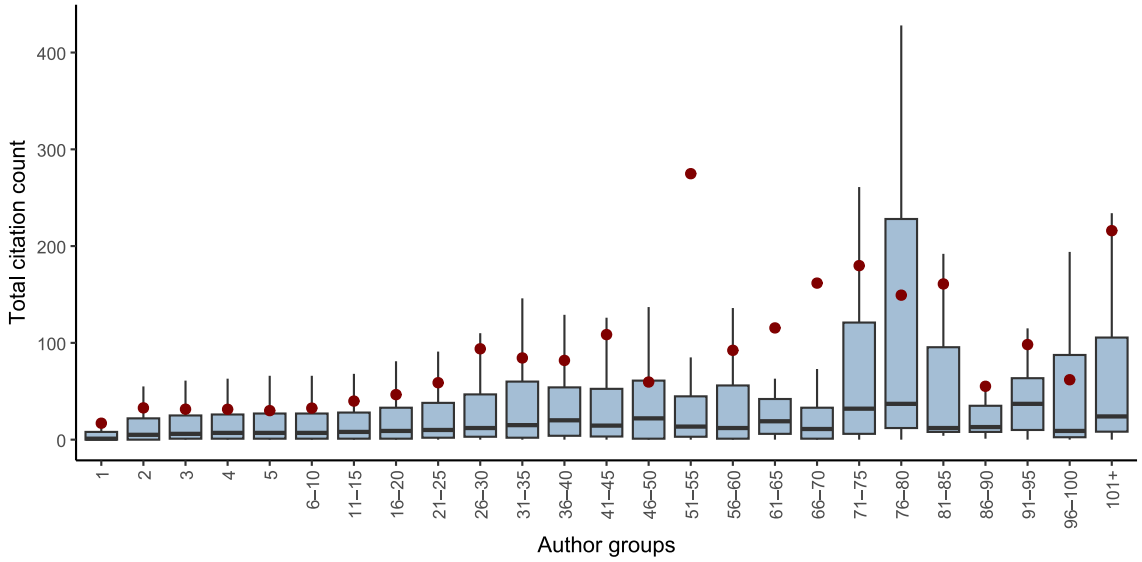


Figure 4

Team size of five and second-year citation counts

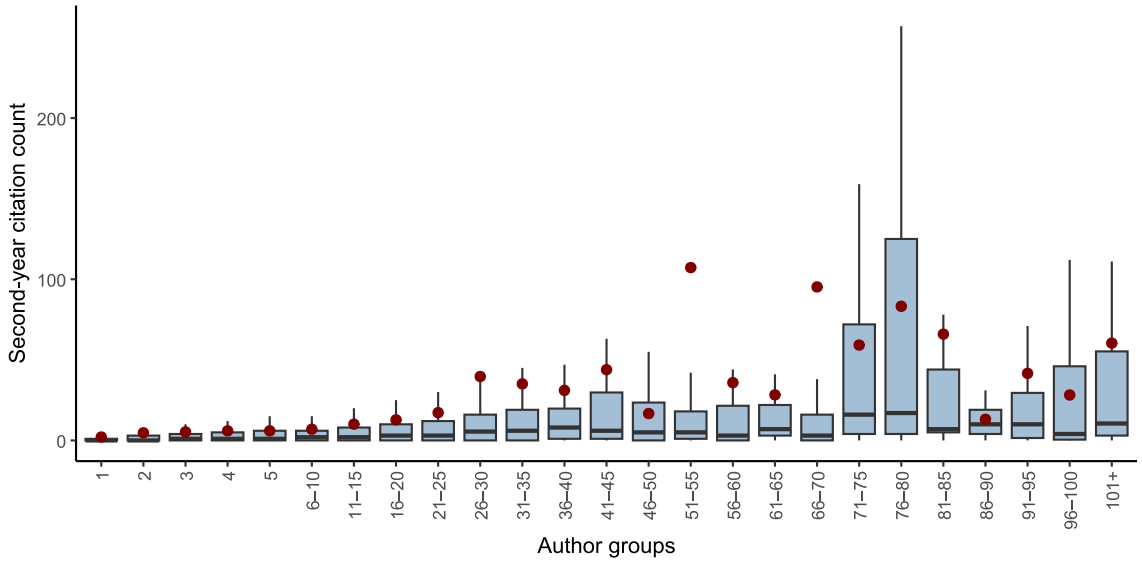


Figure 5

Team size of five and date-corrected citation counts

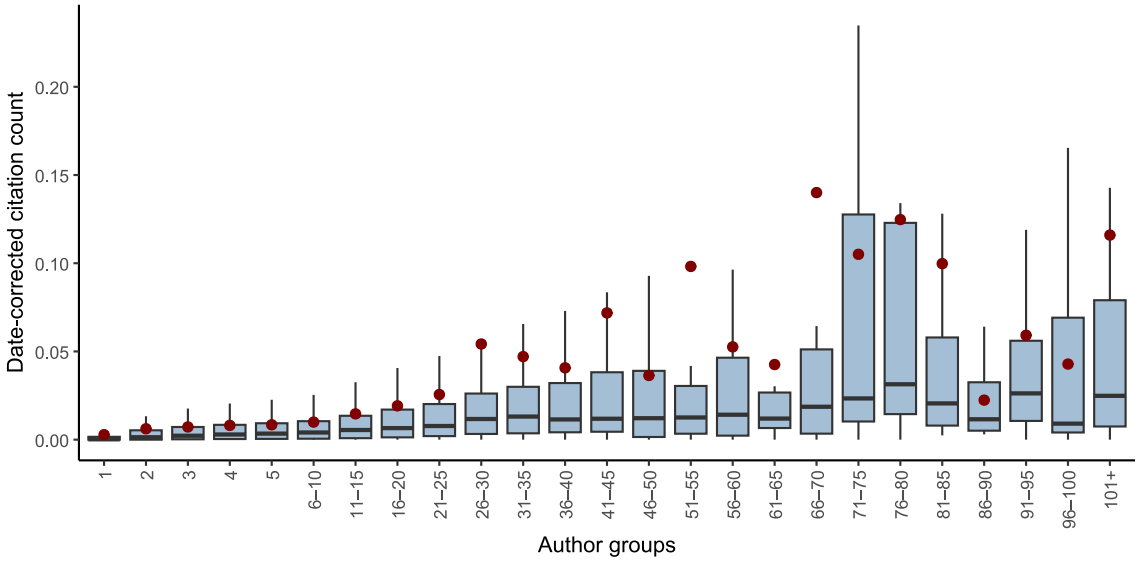


Figure 6

Team size of ten and total citation counts

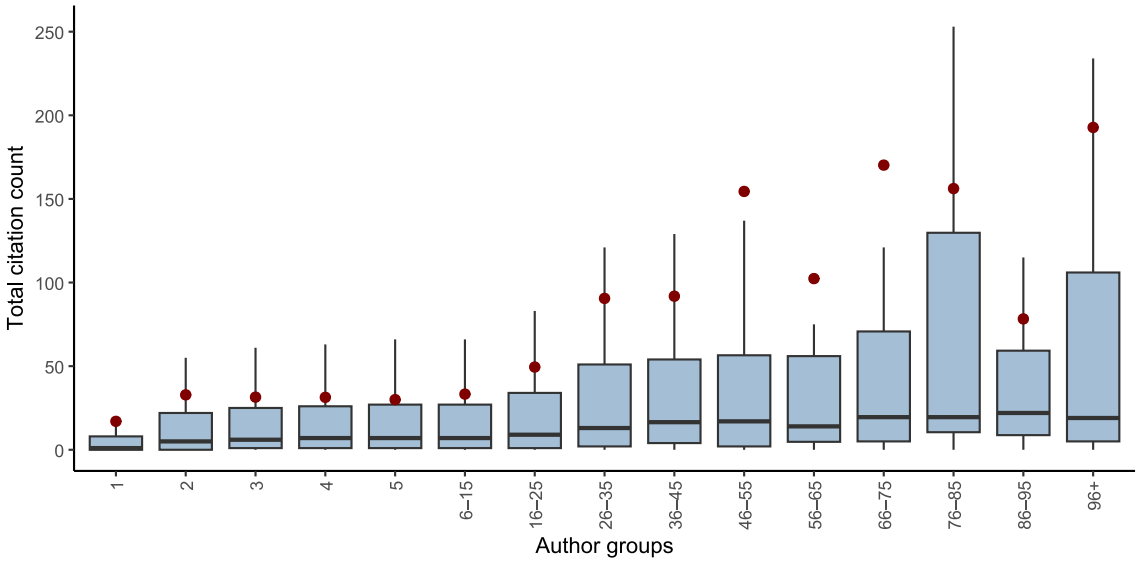


Figure 7

Team size of ten and date-corrected citation counts

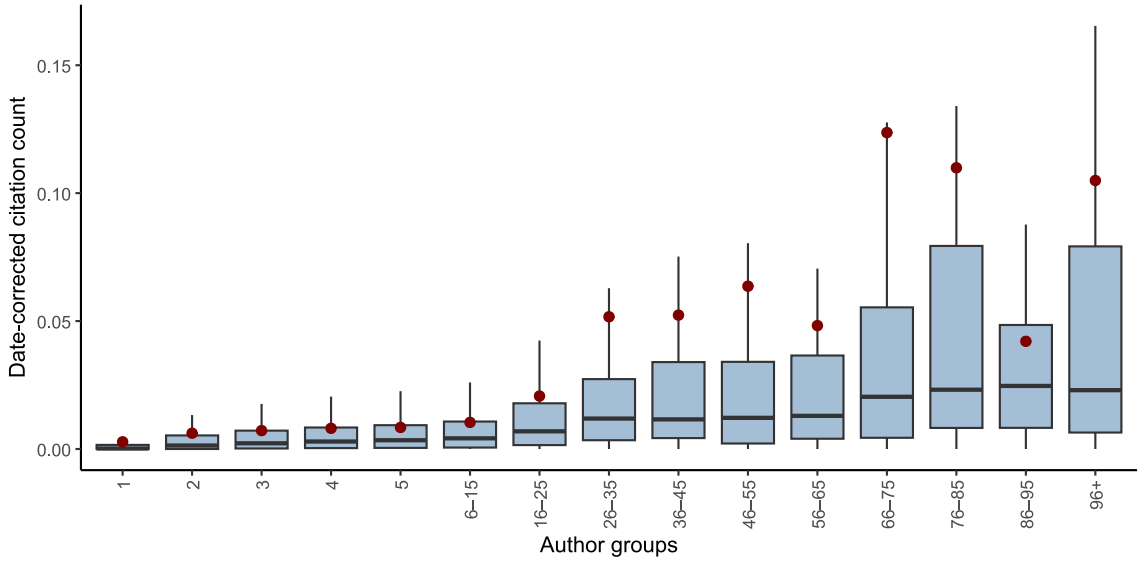


Figure 8

Team size of fifteen and total citation counts

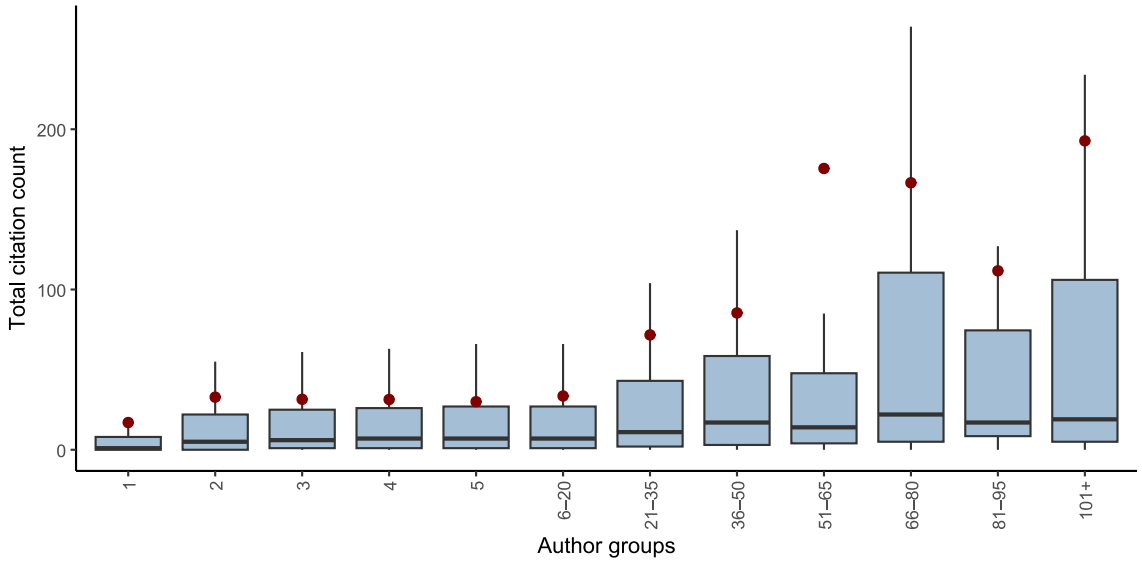


Figure 9

Team size of fifteen and second-year citation counts

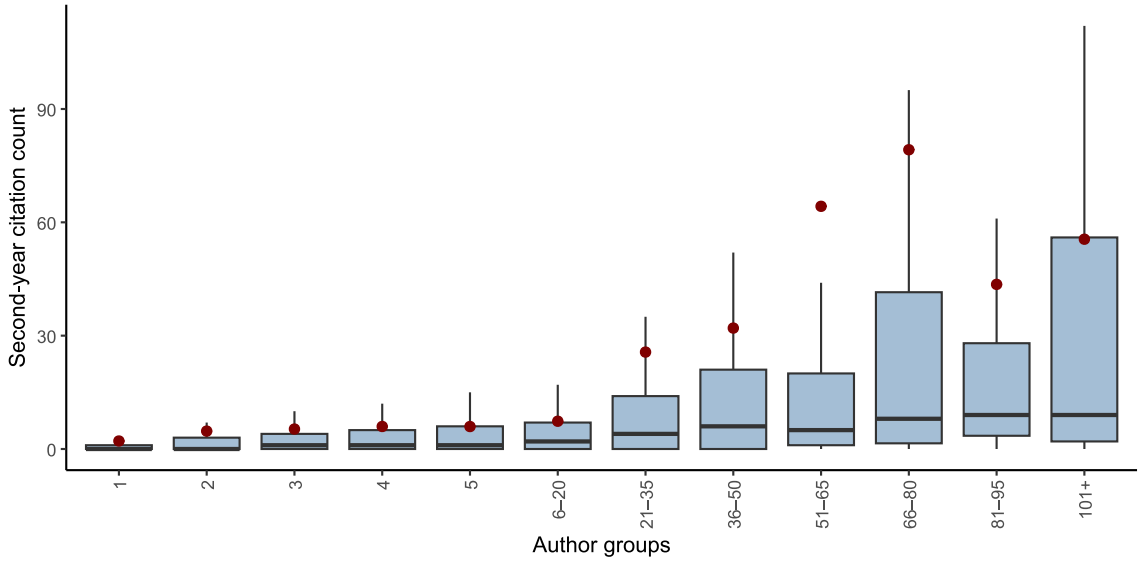
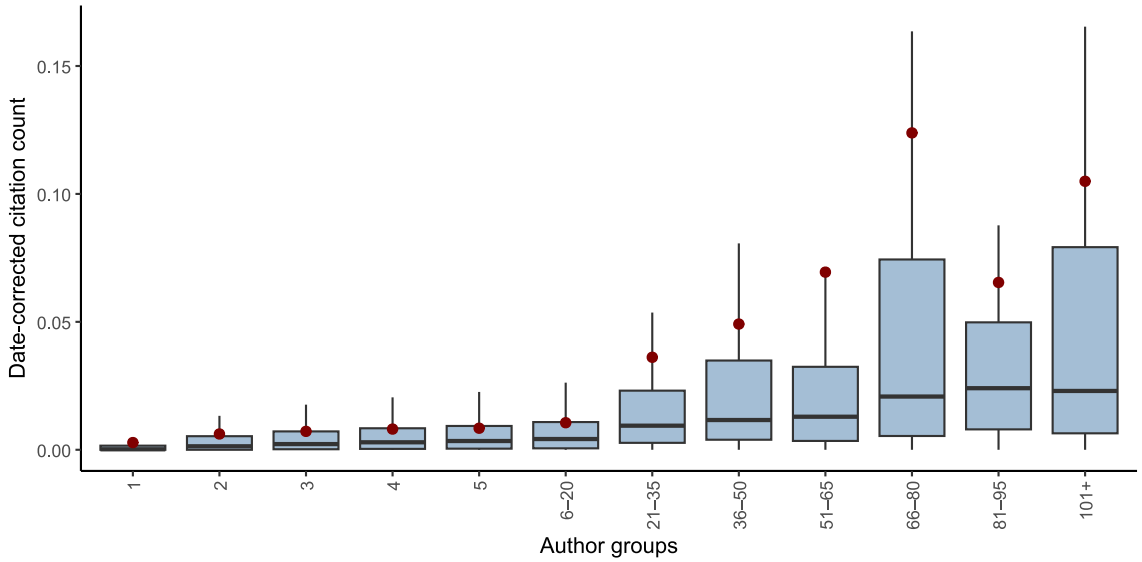


Figure 10

Team size of fifteen and date-corrected citation counts



Tables below show the descriptive results for different citation measures across different team-size definitions.

Table 5

Descriptive statistics of citation measures by team size (groups of five authors)

		Total citation			2-year-citation			Time-corrected citation		
Group size of 5	n	mean	sd	median	mean	sd	median	mean	sd	median
1	539,266	17.00	174.69	1.0	2.12	27.06	0.0	0.00	0.02	0.00
2	397,621	32.84	350.52	5.0	4.74	72.43	0.0	0.01	0.05	0.00
3	289,358	31.48	173.17	6.0	5.28	28.88	1.0	0.01	0.03	0.00
4	185,132	31.37	252.71	7.0	5.96	61.84	1.0	0.01	0.04	0.00
5	110,921	29.99	102.49	7.0	5.94	21.03	1.0	0.01	0.02	0.00
6–10	154,585	32.59	168.15	7.0	6.93	39.67	2.0	0.01	0.05	0.00
11–15	16,691	39.85	303.41	8.0	10.08	73.96	2.0	0.01	0.08	0.01
16–20	3,447	46.53	186.51	9.0	12.76	60.58	3.0	0.02	0.09	0.01
21–25	1,077	58.84	226.74	10.0	17.23	78.13	3.0	0.03	0.12	0.01
26–30	472	93.89	402.38	12.0	39.66	229.89	5.5	0.05	0.29	0.01
31–35	261	84.43	293.66	15.0	35.09	177.81	6.0	0.05	0.21	0.01
36–40	178	81.87	231.05	20.0	31.05	87.01	8.0	0.04	0.10	0.01
41–45	106	108.57	421.03	14.5	43.89	176.13	6.0	0.07	0.29	0.01
46–50	71	59.55	97.97	22.0	16.68	26.05	5.0	0.04	0.09	0.01
51–55	56	274.82	1,596.43	13.5	107.23	665.93	5.0	0.10	0.51	0.01
56–60	43	92.30	279.97	12.0	35.86	135.97	3.0	0.05	0.17	0.01
61–65	33	115.45	230.15	19.0	28.27	54.60	7.0	0.04	0.08	0.01
66–70	33	161.76	550.12	11.0	95.24	381.11	3.0	0.14	0.52	0.02
71–75	29	179.83	437.14	32.0	59.17	122.17	16.0	0.11	0.20	0.02
76–80	13	149.31	212.03	37.0	83.23	130.98	17.0	0.12	0.19	0.03
81–85	19	160.89	450.23	12.0	65.95	186.94	7.0	0.10	0.30	0.02
86–90	13	55.15	118.98	13.0	13.15	12.65	10.0	0.02	0.02	0.01
91–95	15	98.27	237.06	37.0	41.60	94.61	10.0	0.06	0.10	0.03
96–100	11	61.91	94.38	9.0	28.18	43.06	4.0	0.04	0.06	0.01
101+	62	215.95	887.13	24.0	60.39	190.80	10.5	0.12	0.33	0.02

Table 6

Descriptive statistics of citation measures by team size (groups of ten authors)

		Total citation			2-year-citation			Time-corrected citation		
Group size of 10	n	mean	sd	median	mean	sd	median	mean	sd	median
1	539,266	17.00	174.69	1.0	2.12	27.06	0	0.00	0.02	0.00
2	397,621	32.84	350.52	5.0	4.74	72.43	0	0.01	0.05	0.00
3	289,358	31.48	173.17	6.0	5.28	28.88	1	0.01	0.03	0.00
4	185,132	31.37	252.71	7.0	5.96	61.84	1	0.01	0.04	0.00
5	110,921	29.99	102.49	7.0	5.94	21.03	1	0.01	0.02	0.00
6–15	171,276	33.29	185.72	7.0	7.24	44.21	2	0.01	0.05	0.00
16–25	4,524	49.46	196.88	9.0	13.82	65.21	3	0.02	0.10	0.01
26–35	733	90.52	367.19	13.0	38.04	212.70	6	0.05	0.27	0.01
36–45	284	91.83	315.16	16.5	35.84	127.61	6	0.05	0.19	0.01
46–55	127	154.47	1,062.70	17.0	56.61	442.71	5	0.06	0.35	0.01
56–65	76	102.36	258.13	14.0	32.57	107.88	5	0.05	0.14	0.01
66–75	62	170.21	496.54	19.5	78.37	288.74	6	0.12	0.40	0.02
76–85	32	156.19	367.61	19.5	72.97	164.33	11	0.11	0.25	0.02
86–95	28	78.25	189.50	22.0	28.39	70.15	10	0.04	0.07	0.02
96+	73	192.74	819.19	19.0	55.53	176.73	9	0.10	0.31	0.02

Table 7

Descriptive statistics of citation measures by team size (groups of fifteen authors)

		Total citation			2-year-citation			Time-corrected citation		
Group size of 15	n	mean	sd	median	mean	sd	median	mean	sd	median
1	539,266	17.00	174.69	1	2.12	27.06	0	0.00	0.02	0.00
2	397,621	32.84	350.52	5	4.74	72.43	0	0.01	0.05	0.00
3	289,358	31.48	173.17	6	5.28	28.88	1	0.01	0.03	0.00
4	185,132	31.37	252.71	7	5.96	61.84	1	0.01	0.04	0.00
5	110,921	29.99	102.49	7	5.94	21.03	1	0.01	0.02	0.00
6–20	174,723	33.56	185.75	7	7.35	44.60	2	0.01	0.05	0.00
21–35	1,810	71.67	292.20	11	25.65	148.46	4	0.04	0.19	0.01
36–50	355	85.38	285.43	17	32.01	114.94	6	0.05	0.18	0.01
51–65	132	175.52	1,056.17	14	64.24	440.71	5	0.07	0.35	0.01
66–80	75	166.59	458.90	22	79.21	267.42	8	0.12	0.37	0.02
81–95	47	111.66	319.50	17	43.57	130.04	9	0.07	0.20	0.02
101+	73	192.74	819.19	19	55.53	176.73	9	0.10	0.31	0.02

Larger teams are published in more prestigious journals

Team size definition also did not impact the result on larger teams being published in higher rank journals.

Figure 11

Team size of five and journals' prestige

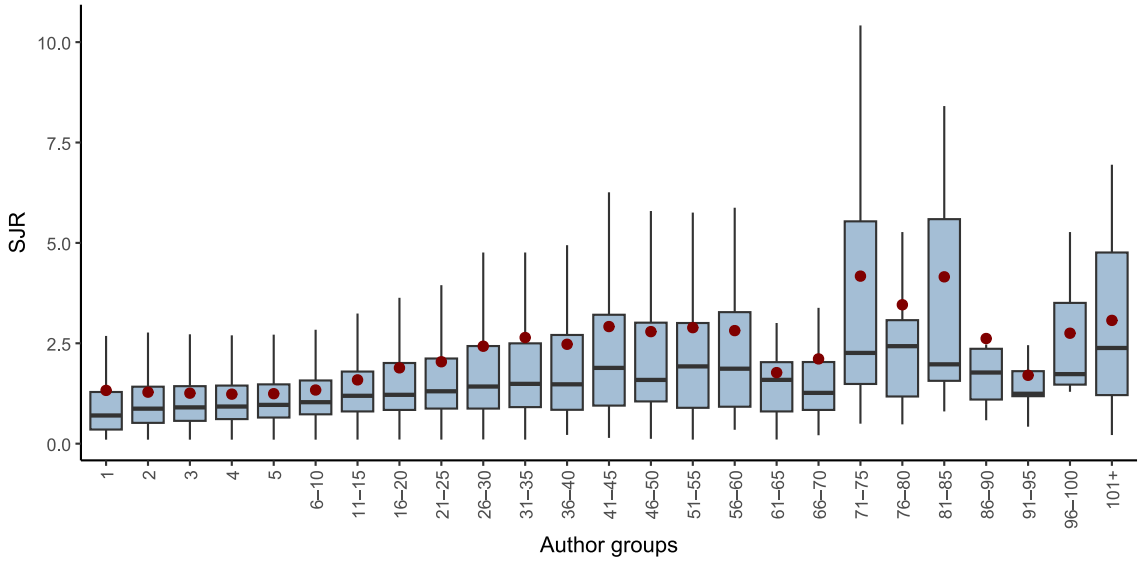


Figure 12

Team size of fifteen and journals' prestige

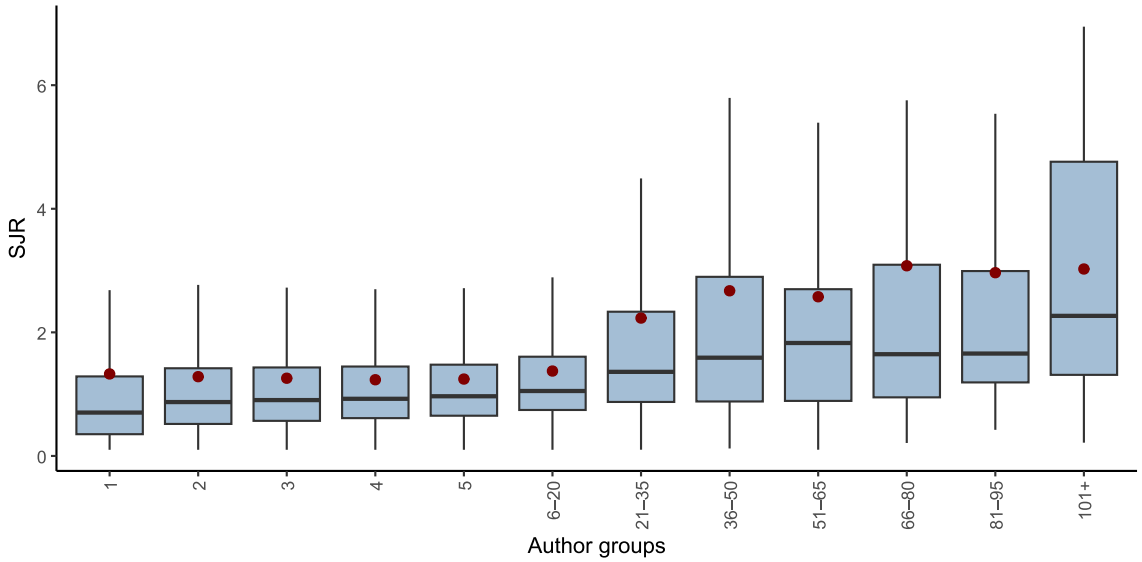


Table 8

Descriptive statistics of journal ranking by team size

		SCImago Journal Rank		
Group size of 10	n	mean	sd	median
1	293,212	1.33	2.37	0.70
2	271,432	1.28	1.75	0.87
3	215,950	1.26	1.49	0.90
4	147,143	1.23	1.29	0.92
5	92,119	1.24	1.22	0.97
6–15	151,874	1.36	1.43	1.04
16–25	4,434	1.92	2.40	1.23
26–35	754	2.50	3.27	1.45
36–45	291	2.64	3.25	1.65
46–55	124	2.83	3.37	1.79
56–65	76	2.36	2.91	1.65
66–75	67	3.00	3.74	1.59
76–85	33	3.88	4.46	2.42
86–95	29	2.15	2.08	1.24
96+	78	3.03	2.32	2.27

		SCImago Journal Rank		
Group size of 5	n	mean	sd	median
1	293,212	1.33	2.37	0.70
2	271,432	1.28	1.75	0.87
3	215,950	1.26	1.49	0.90
4	147,143	1.23	1.29	0.92
5	92,119	1.24	1.22	0.97
6–10	136,019	1.34	1.38	1.03
11–15	15,855	1.59	1.73	1.19
16–20	3,362	1.89	2.34	1.22
21–25	1,072	2.04	2.55	1.31
26–30	488	2.43	3.14	1.42
31–35	266	2.64	3.50	1.49
36–40	180	2.48	3.16	1.48
41–45	111	2.92	3.39	1.89
46–50	72	2.79	3.22	1.59
51–55	52	2.89	3.61	1.92
56–60	43	2.82	3.61	1.87
61–65	33	1.77	1.44	1.59
66–70	38	2.11	2.47	1.27
71–75	29	4.17	4.73	2.26
76–80	13	3.46	4.63	2.43
81–85	20	4.16	4.44	1.98
86–90	14	2.62	2.65	1.77
91–95	15	1.70	1.30	1.24
96–100	11	2.75	1.87	1.73
101+	67	3.07	2.39	2.38

		SCImago Journal Rank		
Group size of 15	n	mean	sd	median
1	293,212	1.33	2.37	0.70
2	271,432	1.28	1.75	0.87
3	215,950	1.26	1.49	0.90
4	147,143	1.23	1.29	0.92
5	92,119	1.24	1.22	0.97
6–20	155,236	1.37	1.45	1.05
21–35	1,826	2.23	2.88	1.36
36–50	363	2.67	3.24	1.59
51–65	128	2.58	3.21	1.83
66–80	80	3.08	3.87	1.65
81–95	49	2.97	3.37	1.66
101+	78	3.03	2.32	2.27

Papers authored by larger teams are more likely to be published in higher impact journals, and receive more citations

Regardless of the definition of impact (i.e., total citation, 2-year citation, date-corrected citation, journal rank), pursuing impact in a smaller team is a risky strategy. To have a chance to outperform the median total citation, 2-year citation, date-corrected citation, and SJR of larger author papers, small teams have to be at the top 31.51th, 19.61th, 15.41th, and 25.26th percentile respectively.

Figure 13

Percentiles of total citation and second-year citation metrics based on group size of 5

Figure 13a

Groups of five - Total citation

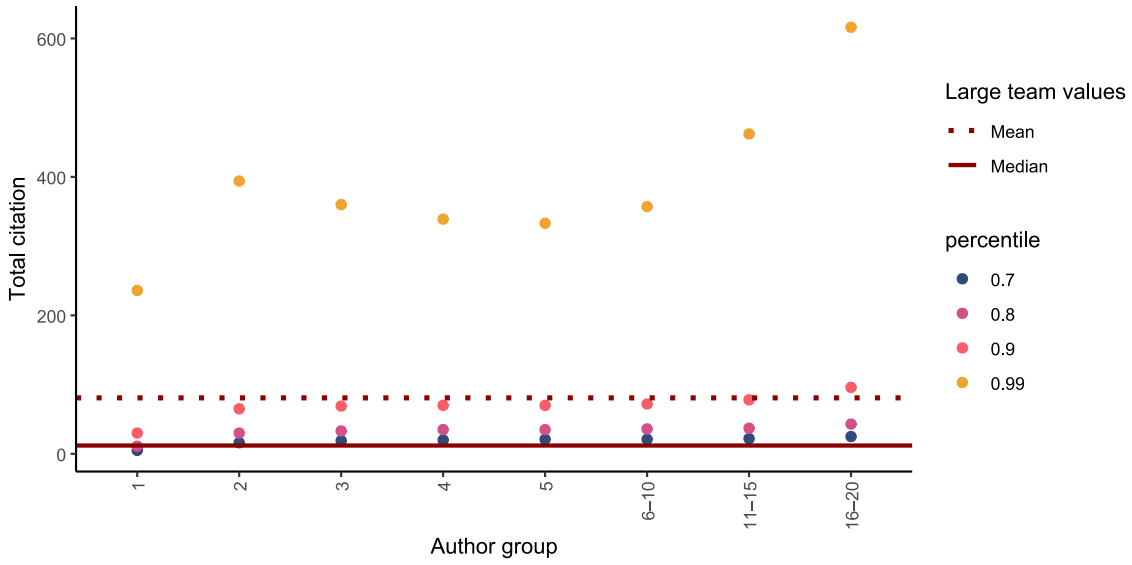


Figure 13b

Groups of five - Second-year citation

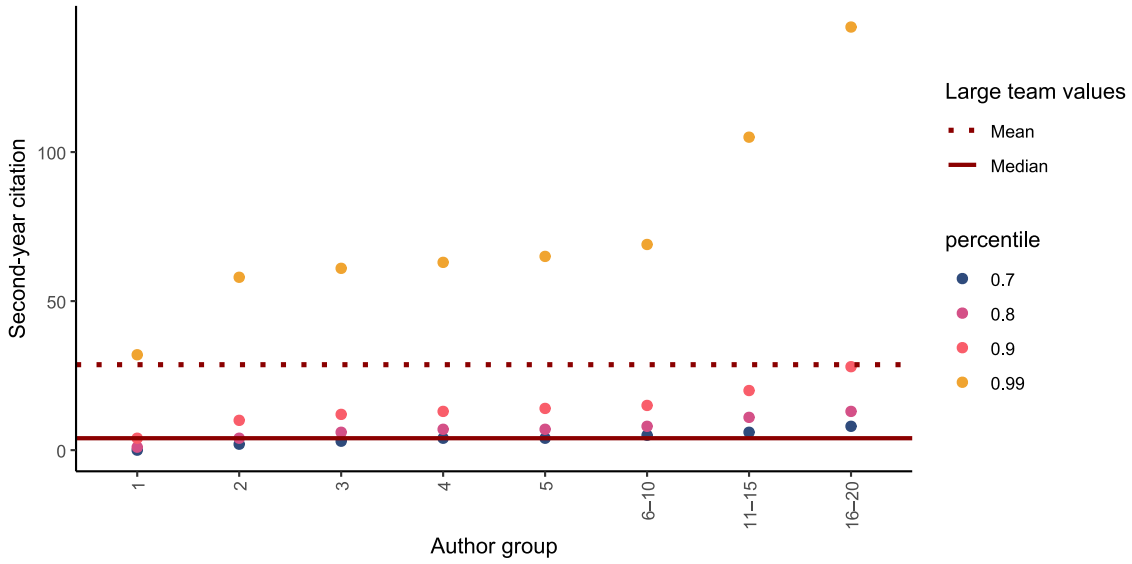


Figure 14

Percentiles of date-corrected citation metrics and SJR based on group size of 5

Figure 14a

Groups of five - Date-corrected citation

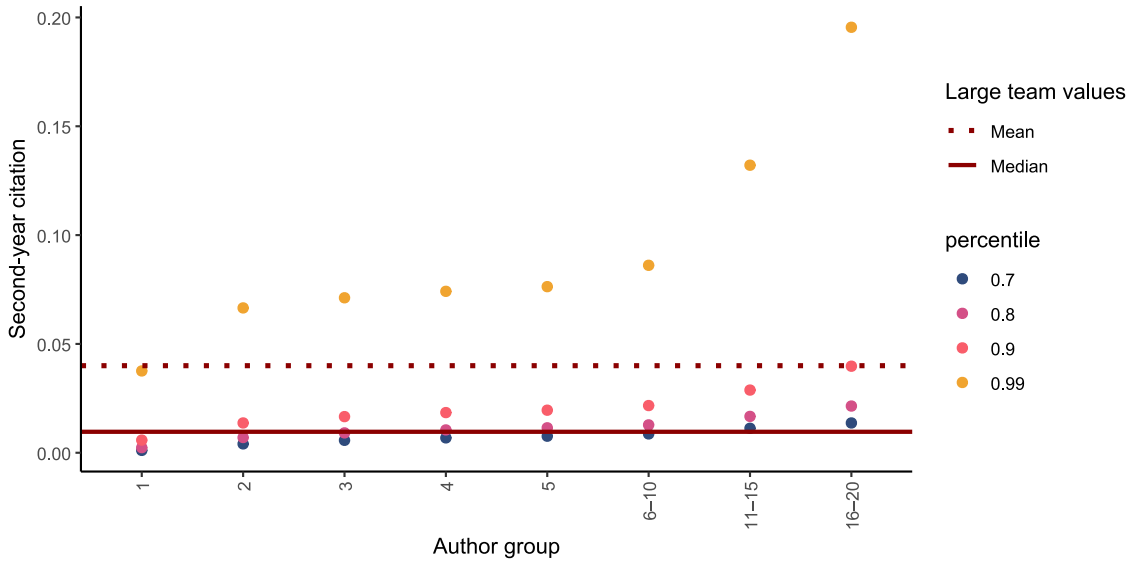


Figure 14b

Groups of five - SJR

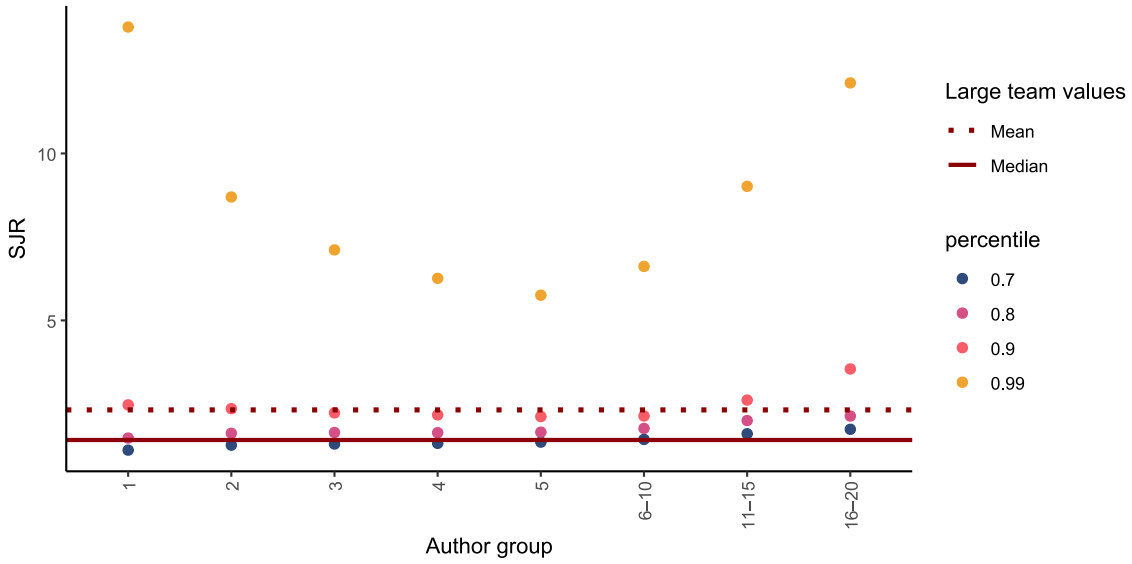


Figure 15

Percentiles of total citation and date corrected and SJR based on group size of 10

Figure 15a

Groups of ten - Total citation

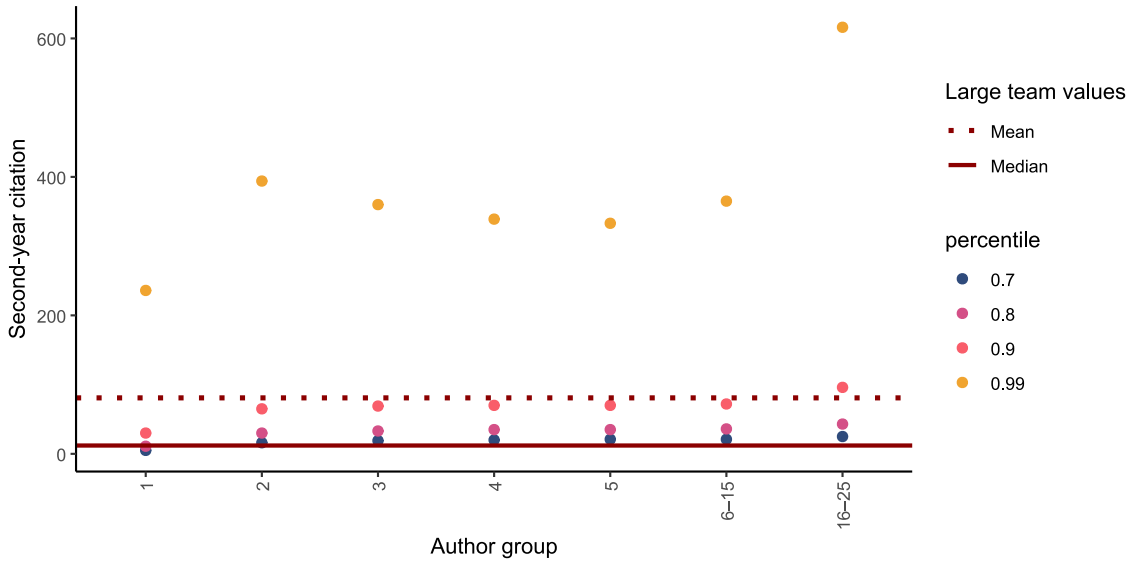


Figure 15b

Groups of ten - Date-corrected citation

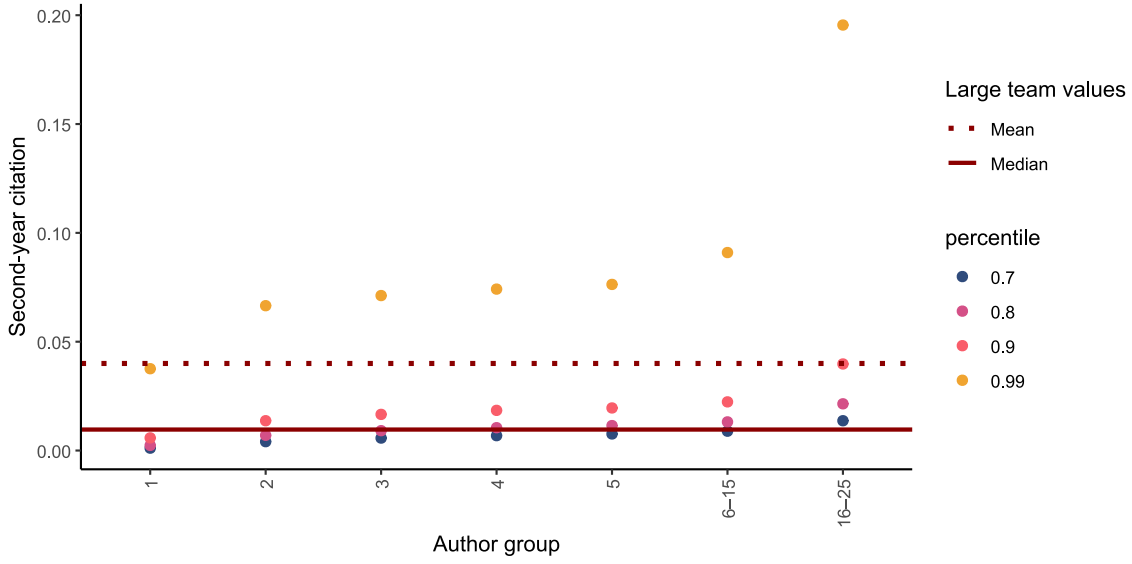


Figure 16

Percentiles of total citation and second-year citation metrics based on group size of 15

Figure 16a

Groups of fifteen - Total citation

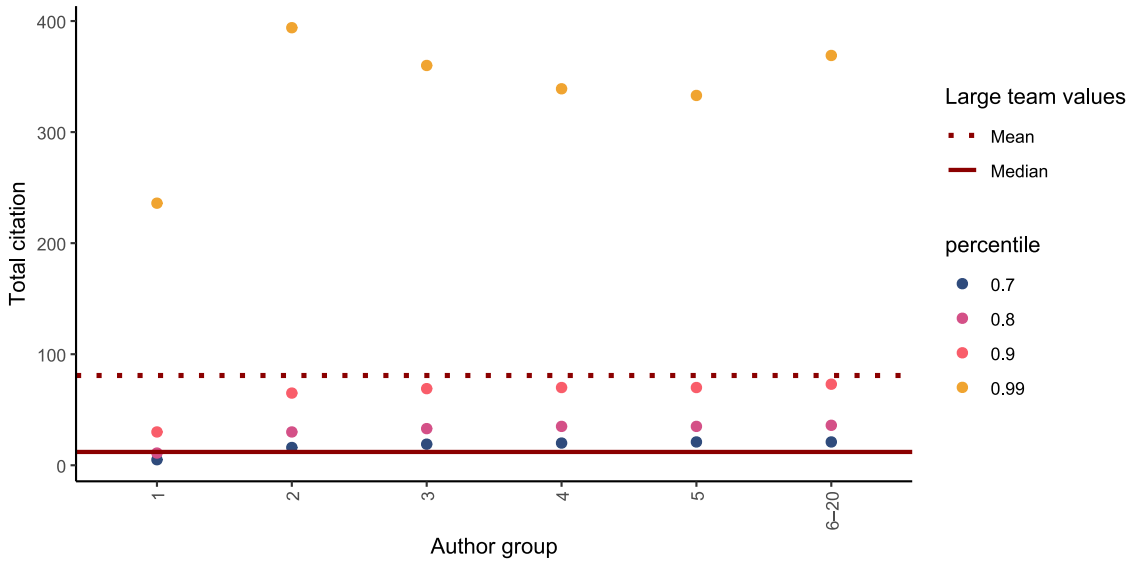


Figure 16b

Groups of fifteen - Second-year citation

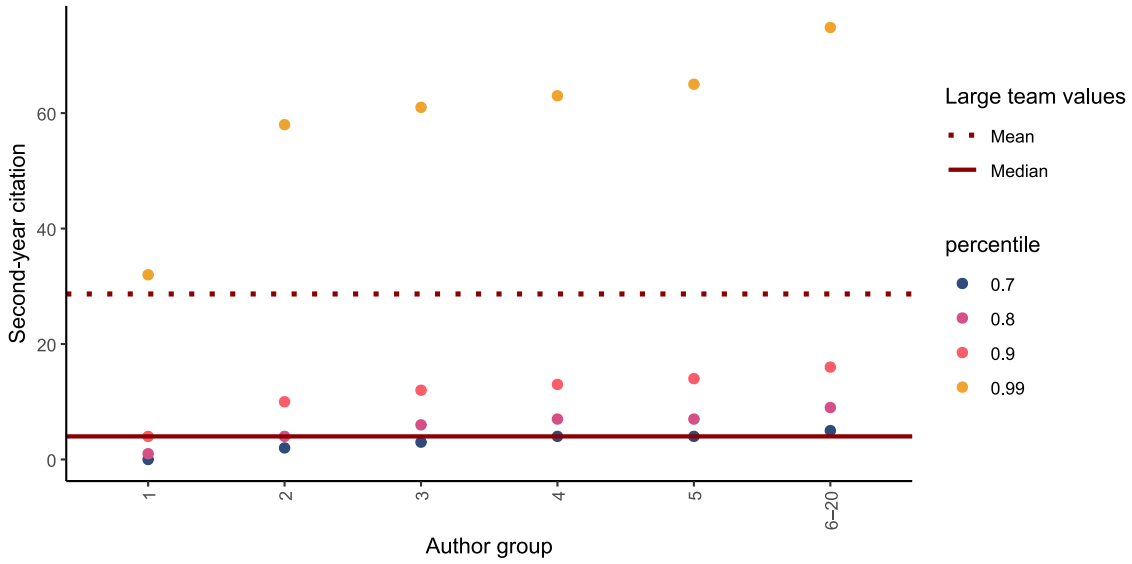


Figure 17

Percentiles of date-corrected citation metrics and SJR based on group size of 15

Figure 17a

Groups of fifteen - Date-corrected citation

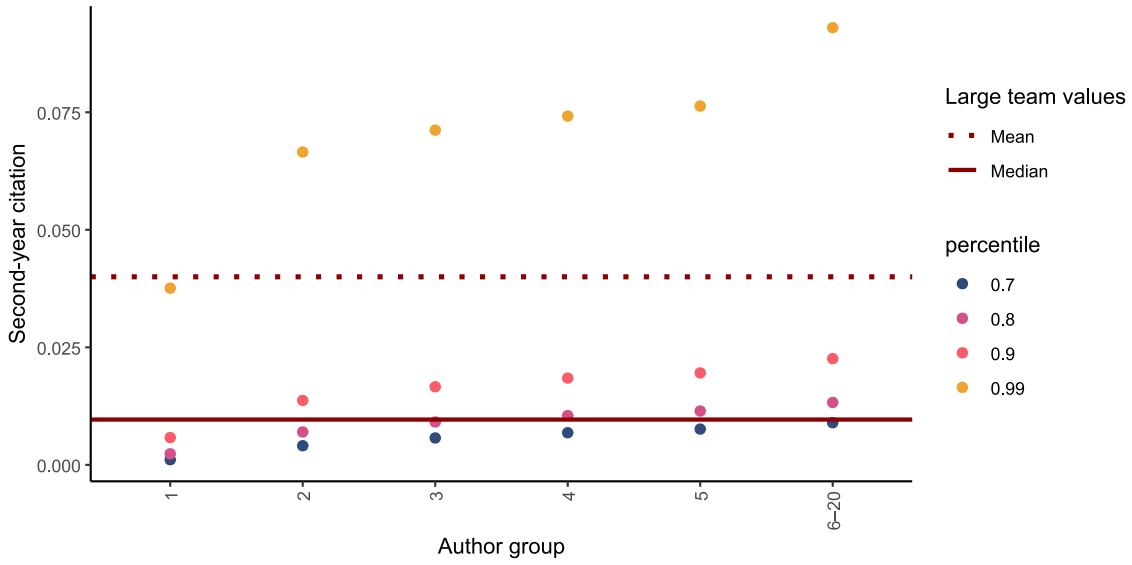
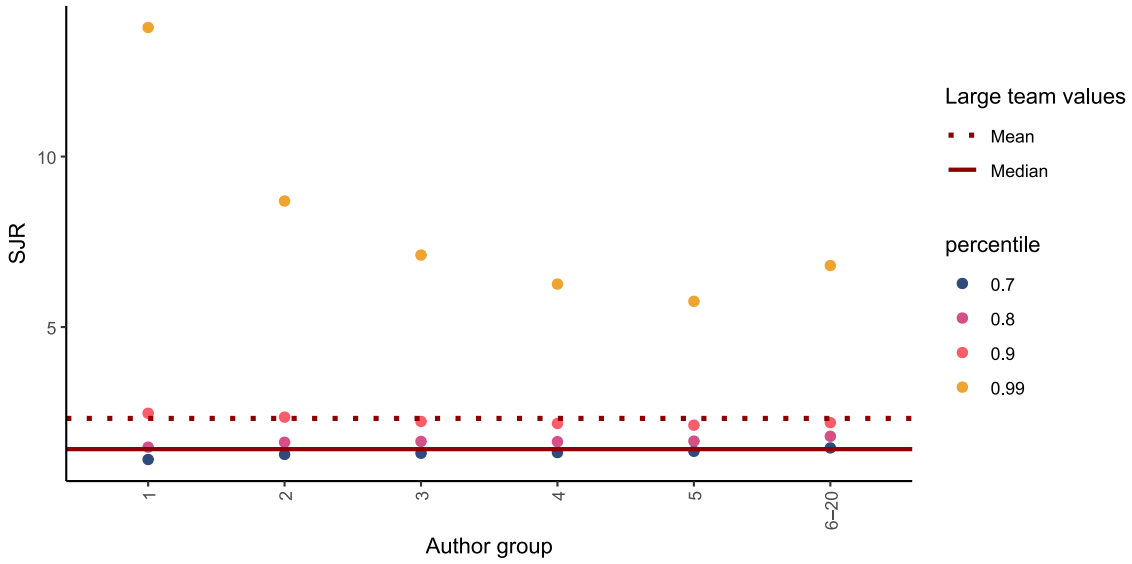


Figure 17b

Groups of fifteen - SJR



Large-team papers are consistently authors' more successful publications

Regardless of the definition for large teams (i.e., number of authors more than 15 and 25), larger teams papers are consistently authors' more successful publications. The Wilcox rank-sum test was significant for all the tests at the level of $p < .001$. For the first case (i.e., large teams define as having 15 or more authors) we had 30647 eligible authors for citation metrics and 27798 authors for journal ranking for the test. The results of the test of medians for small-team publication and large-team publications of authors were $W = 540290787$, $CI = [4, \infty)$ for total citation, $W = 615472554.5$, $CI = [3, \infty)$ for second-year citation, $W = 664563035.5$, $CI = [0.007, \infty)$ for date-corrected citation, and $W = 490037480$, $CI = [0.338, \infty)$ for SJR. Regarding the second definition of large teams (i.e., large teams define as having 25 or more authors), we had 14700 and 13617 eligible authors for citation metrics and journal rankings. Similarly, the results of Wilcox rank-sum test was significant for all the tests at the level of $p < .001$. (median of total citation ($W = 138835422.5$, $CI = [11, \infty)$), second-year citation ($W = 156498846.5$, $CI = [7, \infty)$), date-corrected citation ($W = 170589128.5$, $CI = [0.014, \infty)$), and SJR ($W = 131249694.5$, $CI = [0.69, \infty)$).

When large teams are defined as having 15 or more authors, the median number of citations for large-team publications in their second year is, on average, 24.08 higher than for publications by smaller teams (five or fewer authors). This number for total citation and publication-date–corrected citation are 71.78 and 0.04 respectively. Similarly, the median SJR of large-team publication of researchers is, on average 1.5 higher than their smaller group publications. For author group of ≥ 25 of researchers, these differences are 47.85 for second-year citation, 136.48 for total citation, 0.07 for publication-date–corrected citation, and 1.5 for the journal ranking.

Figure 18

Performance of small-team project papers compared to large-team project papers of the same author

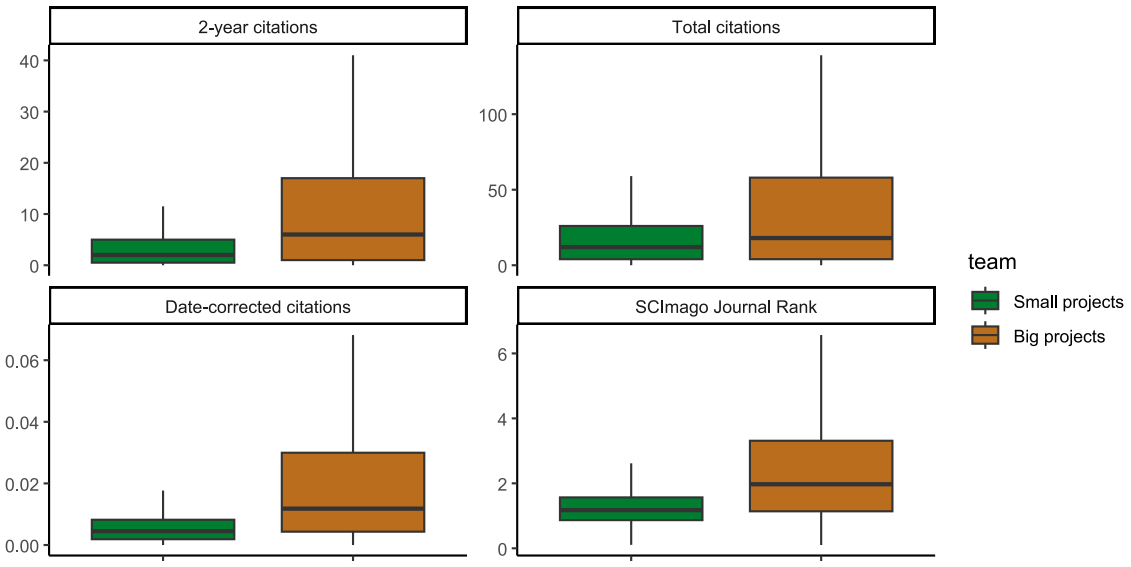


Figure 19

Performance of small-team project papers compared to large-team project papers of the same author