

AUTHOR COLLABORATION AND IMPACT:
A NOTE ON CITATION RATES OF SINGLE
AND MULTIPLE AUTHORED
ARTICLES

J. C. SMART, A. E. BAYER

*Department of Sociology, Virginia Polytechnic Institute and
State University, Blacksburg, Virginia 2406 (USA)*

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The acceptance rate of articles which are collaboratively authored tends to be higher than that for single-authored papers, thereby suggesting a generally positive relationship between collaboration and quality. The analysis of ten-year citation rates of 270 randomly selected articles in three applied fields likewise shows a similar relationship, with somewhat higher citation frequencies for multi-authored papers than for single-authored ones. The relationships persist whether self-citations are included or excluded. However, these differences are not statistically significant for articles in clinical psychology or in educational measurement. Only multi-authored articles in management science show a statistically significant higher citation rate. Other aspects of the collaborative process and effects are discussed.

Introduction

The rapid growth of scientific collaboration throughout this century has been widely documented.^{1–3} Increasing evidence has likewise been presented about changes in the fundamental nature of contemporary science that have contributed to the emergence of this phenomenon.^{2,4–8} Much less settled, however, is the issue of the extent to which published works emanating from collaborative efforts are of higher quality than those based on the efforts of individual scientists. This issue is of major significance given the phenomenal growth of collaborative research in most fields and its emergence as essentially “a functional requirement of contemporary scientific investigation”.⁹

Moreover, there is growing interest in how different types of collaborative arrangements may impact on the salience of the resulting scholarly products, and on how these collaborative arrangements may vary between disciplines or fields. *Hagstrom*,¹⁰ for example, proposes three generic types of collaboration (complementary, supplementary, and master-apprentice), and *Lawani*¹¹ suggests that some of these

collaborative arrangements are more fruitful than others. More recently, *Bayer*¹² proposes that it may be field-specific differences in the predominating types of collaboration which could yield discrepant findings between fields on the impact of single-versus multi-authored works.

At present, there is no body of research which ascertains the relative impact of various types of collaborative arrangements. Indeed, more general attempts to investigate the relative quality of collaborative research have been few in number and based primarily on differences in the merits of single-versus multi-authored papers. The principal criteria used to assess the quality of these respective forms of scholarship have been manuscript acceptance rates in scholarly journals and the number of citations received by published works. Studies based on manuscript acceptance rates have tended to show a positive relationship between collaboration and indices of quality. For example, a positive relationship was found between the number of authors of astronomy¹³ and sociology¹⁴ papers and their probability of acceptance for publication by leading journals in these fields.

At the same time, however, research based on the citation rates of published works has tended to show little or no difference in the quality or impact of single-versus multi-authored papers in various disciplines. *Oramaner*,¹⁵ for example, reported no substantial difference in the citation rates of single and multiple authored sociology papers. Likewise, *Lindsey*¹⁶ found no overall difference in the number of citations received by single- and multi-authored papers in six academic disciplines. *Lindsey* did report, however, that there appeared "to be a consistent proportional increase in citations attracted and number of authors" in two applied fields, social work and psychiatry (p. 84). Nevertheless, *Bayer*¹² in his assessment of the applied area of family science, found no relationship between collaboration and citation frequency. The weight of extant evidence thus appears to vary based on which criterion is used in investigations of the quality of these forms of scholarship and on which fields of science are studied.

The current analyses focus directly on the relative quality of collaborative research through an assessment of ten-year citation rates for single and multiple authored papers in the leading journals of three applied science fields. If consistently similar findings to *Lindsey*'s results for applied fields as against disciplinary areas should be found for these three additional applied fields, then it would imply some further exploration of variations in collaborative style as an explanation of these observed differences. The corollary issue of self-citation practices in collaborative research is also examined since multiple authorship clearly has the potential to disproportionately "inflate" citation rates and thus distort the assumed quality of research produced through bibliometric assessment of collaborative efforts.

Research procedures

Assessment of the relative impact and self-citation practices in applied research was based on the number of citations received by a random sample of single- and multi-authored papers published during the 1971 calendar year in the three leading specialty journals in clinical psychology,¹⁷ management science,¹⁸ and educational measurement.¹⁹ These fields were chosen because of their applied character and *Lindsey's* tentative suggestion that collaboration and quality might be positively related in applied fields.

A total of 15 single and 15 multiple authored articles were randomly selected from the 1971 calendar year issues of each journal. Thus, the study sample included 90 articles for each of the three fields, or a total of 270 journal articles. Table 1 presents the sampling proportions of single and multiple authored papers for each journal and each of the three fields.

Citation and self-citation data

Citations are bibliographic references to publications and have been used repeatedly to assess the merits of scientific publications.^{20,21} The use of citations as a measure of research quality is based on the assumption that scientists and their published works receive citations in proportion to the degree to which their ideas and findings constitute a contribution to the advancement of knowledge.²² Citation frequency counts have been shown to be positively associated with the eminence of individual scientists,^{23,24} the prestige of academic departments in research universities^{25,26} and the relative stature of scholarly journals,^{27,28} as assessed by other measures (e.g. peer ratings). Thus, citation rates are used to examine potential differences in the relative quality or impact of multiple authored versus single authored papers in the three fields assessed in the current study.

The frequency with which the 270 articles were cited in the research literature during the decade following their publication in 1971 was the criterion used to assess their relative impact. The number of citations received by each article was obtained by an online search of the *Social Science Citation Index (SSCI)* from 1972 through 1981. Hard copy prints of citations were obtained and used to identify self-citations to each of the sample articles. These prints made it possible to identify self-citations by *both* senior and junior authors of the multiple authored papers.

Self-citations are bibliographic references by authors to one or more of their previous publications and constitute a principal basis for objections to the use of

Table 1
Sampling proportions of single and multiple authored articles^a

Social science field and journal title	Single authored			Multiple authored			Total		
	Number published	Number sampled	Percent sampled	Number published	Number sampled	Percent sampled	Number published	Number sampled	Percent sampled
Clinical Psychology ^b									
<i>Journal of Consulting and Clinical Psychology</i>	65	15	23.0	76	15	19.7	141	30	23.1
<i>Journal of Abnormal Psychology</i>	22	15	68.2	65	15	23.1	87	30	34.5
<i>Journal of Clinical Psychology</i>	47	15	31.9	114	15	13.2	161	30	18.6
TOTAL	134	45	33.6	255	45	17.6	389	90	23.1
Educational Measurement ^c									
<i>American Educational Research Journal</i>	17	15	88.2	23	15	65.2	40	30	75.0
<i>Educational and Psychological Measurement</i>	35	15	42.9	20	15	75.0	55	30	54.5
<i>Journal of Educational Measurement</i>	32	15	46.9	19	15	78.9	51	30	58.8
TOTAL	84	45	53.6	62	45	72.3	146	90	61.6
Management Science ^d									
<i>Administrative Science Quarterly</i>	27	15	55.6	15	15	100.0	42	30	71.4
<i>Management Science</i>	84	15	17.9	38	15	39.5	122	30	24.6
<i>Harvard Business Review</i>	55	15	27.3	21	15	71.4	76	30	39.5
TOTAL	166	45	27.1	74	45	60.8	240	90	37.5

^aExcludes communications, replies and rejoinders, commentaries, brief reports, and notes and review essays.

^bRef. 17.

^cRef. 19.

^dRef. 18.

citation frequency data as a measure of research quality or impact.^{21,29,30} Extant findings indicate that self-citations often account for ten to twenty percent of the total number of citations received by published articles.³¹⁻³³ Self-citations could be especially troublesome in the use of citation rates to assess the relative impact of single versus multiple authored articles since the presence of multiple authors would enhance the likelihood of self-citations, and thus "inflate" the total citation counts of collaborative research. Consequently, all analyses are reported both including and excluding self-citations.

Findings

The mean number of citations per paper is consistently lower for single-authored than for multi-authored papers in each of the three applied fields (Table 2). For total citations, multi-authored papers in these three applied fields yield from 18 percent to 70 percent more references over the ensuing ten years than do single-authored papers. Excluding self-citations, the average multi-authored paper yields from 18 percent to 64 percent more citations.

However, the data for these summary statistics reflect extreme variances and are highly skewed, consistent with the results of virtually all other studies of research publication and citation (e.g., see the reviews of *Walberg et al.*³⁴ and *Gordon et al.*³⁵). Each of the three applied fields exhibited markedly non-normal distributions of citation counts. Consequently, rather than undertaking a statistical test of differences between means, the Mann-Whitney U-test, which does not require assumptions about the shape of the underlying distribution, was employed.

For two of the three applied fields investigated, the nonparametric test of difference between the citation frequency of single- and multi-authored papers did not approach statistical significance. In only Management Science did multi-authored works (both including and excluding self-citations) garner a statistically significant higher citation rate than single-authored works (Table 3).

Discussion and conclusions

While there are great disparities in the rates of collaboration between "hard" and "soft" sciences and between "pure" and "applied" areas, there is clear evidence of a dramatic rise in collaborative scholarship during this century across virtually all fields and disciplines. Yet we know little about how collaboration influences the quality of the scholarly enterprise, less on how this may vary by field, and almost

Table 2
Average ten-year citation frequency of single- and multi-authored papers, with and without self-citations, by field

Field	With self-citations			Without self-citations				
	Single-authored		Multi-authored	Single-authored		Multi-authored		
	\bar{X}	s.d.	\bar{X}	s.d.	\bar{X}	s.d.		
Clinical Psychology	10.31	10.81	12.67	28.16	9.00	10.28	12.11	27.93
Management Science	10.67	21.68	12.64	15.04	10.27	21.25	12.09	14.72
Educational Measurement	4.96	7.43	8.42	13.06	4.71	7.41	7.73	12.49

Table 3
Mann-Whitney U-test of differences in ten-year citations of single- and multi-authored papers,
with and without self-citations, by field

Field	With self-citations			Without self-citations		
	U	Z	p*	U	Z	p*
Clinical psychology	885.0	-1.03	0.30	956.5	-0.45	0.65
Management Science	698.5	-2.54	0.01	693.5	-2.58	0.01
Educational Measurement	884.5	-1.04	0.30	914.5	-0.80	0.42

*Two-tailed, corrected for ties.

nothing of how various types of collaborative arrangements may vary between fields or impact on the quality of the scholarly products.

In this research note, we provide additional new data to expand on the knowledge base regarding the general impact of collaboration and to add results for three heretofore unanalyzed fields to the growing base of assessments of various fields and disciplines.

In the larger framework of empirical results on the impact of collaboration, particularly that of *Lindsey*,¹⁶ we had expected that applied fields, in contrast to disciplinary areas, might indeed reflect a significant positive influence of collaborative enterprise. If so, this would be indirect confirmatory evidence that scholarly areas might vary in the modal type of collaboration undertaken, and that it was variations in collaborative styles which could be hypothesized to explain differences between fields. More specifically, following *Hagstrom*,¹⁰ conclusive results would have yielded the hypothesis that applied fields more heavily rely on complementary collaboration (i.e., cross-disciplinary teams), providing greater enrichment of product (i.e., citation impact), than do disciplinary collaborative efforts, which may draw more upon less fruitful supplementary or master-apprentice collaborative arrangements.

However, the present research further sustains the conclusion that collaboration generally has little effect on aggregate quality, regardless of field, as measured by citation indices. Moreover, while it may be that self-citation opportunity is substantially enhanced for collaborative works, whether or not self-citations are excluded yields little difference in results.

In conclusion, these results, in conjunction with other studies on other fields and disciplines, provide only sparse and nonsignificant evidence of any incremental advantage to collaboration, at least as measured by citations to works. Of course, other gains from collaboration may be apparent—a more productive quantitative

output of scientific knowledge, more efficient use of scientific technology, and more subjective positive involvement of individuals in the research and writing process.

The question of whether various types of collaboration may also yield significant differences in the product is also not resolved by the present data. Hence this research note ends with a call for further conceptualization of various types of collaborative and team research, and further empirical work on the relative impact of each type. The tremendous expansion in collaborative science requires greater research attention to the effects and the conditions under which it contributes to the growth and the utility of knowledge.

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