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ABSTRACT

In this article we examine changes in the patterns of collaboration among information systems researchers since 1987, in terms of number of authors and order of authorship. The proportion of multiple authored papers, particularly among articles published in more prestigious journals, increased significantly. One possible explanation may be in increased research complexity, as evidenced by much longer papers. At the same time, among prestigious journals, the alphabetical model for ordering authorship all but disappeared. The article calls for consideration of a standard for authorship order in IS research.

Keywords: information systems research, authorship order, multiple authorship, IS journals, research collaboration

I. INTRODUCTION

As a community, researchers in information systems are interested in discussing the nature of their discipline, especially in terms of research content, [e.g., Dickson, Benbasat, and King, 1980], the publishing process and the form of the resulting publications, [e.g., Lee, 2000], and the balance between relevance and rigor [Kock, et al., 2002].

Largely escaping notice in the IS research community, however, is the manner in which we work together as authors in the discipline and how we distribute the resulting credit for our work. In the broader research community, across the university, these questions attracted attention as it became apparent that patterns of author collaborative research changed in recent years. Research collaboration is now a common practice in the academy and increased multiple authorship are observed in publications across various disciplines, e.g., economics [Zuckerman, 1967], psychology [Over 1982, Strahan 1982, Sacco and Milanna 1984, Iammarino, O'Rourke, Pigg and Weinberg, 1989], counseling [Gladding, 1984] and chemistry [Bayer and Smart, 1991].

Once researchers collaborate on IS research, the question arises about how to apportion authorship credit and the resulting professional recognition among the collaborators. This apportionment is done primarily through order of authorship in the resulting publications. Name ordering is often considered an adaptive device that symbolizes different authors' relative contributions to research, in various terms, such as whose idea the paper was, who plans and

directs the research, whose funds pay for it, or who does the work. An assumption, however, that order of authorship reflects relative author contribution may be problematic. Among medical researchers, having a surname with an initial letter at the beginning rather than the end of the alphabet is an advantage for order of authorship [Chambers, Boath, and Chambers, 2001], indicating that at least a substantial number of papers are ordered alphabetically by author surname. Zuckerman [1967] found Nobel laureates often exercise their noblesse oblige by giving credit to less eminent co-workers. Bayer and Smart [1991] also found that those who are disproportionately concentrated in being later-named co-authors in team research are more likely to be listed in *Who's Who in America* [1988]. Although many IS researchers point to their collaborative research with pride, difficulties may arise when researchers disagree about order of authorship and who deserves authorship credit. Perhaps worse, subordinated authors may feel resentment if they feel that authorship order was determined arbitrarily and unfairly. The problem seems to be particularly severe in psychology, counseling, and biomedical research. To resolve the problem, some disciplines established ethical guidelines for authorship credit and order. The guidelines vary among disciplines, however, creating the potential for conflict in cross-discipline collaboration [Holaday and Yost, 1995].

Some disciplines are clearer than others on the issue of authorship sequence [Jones, 1999; Over, 1982]. For example, psychologists usually list authors in the order that each contributed to the published research in accordance with the "Ethical Standards of Psychologists" of the American Psychological Association [Over, 1982]. The American Counseling Association "Code of Ethics," however, is vague about authorship sequence [Jones, 1999].

In IS, Robey [2001] advocates ordering authors by contribution or by alphabet, where authors contribute equally. Contribution might be defined by project leadership, initiation, or other criteria.

II. WHY IS AUTHOR ORDER IMPORTANT?

For the IS researcher, publication is perhaps the most important determinant of success in an academic career. As competition for the most desirable academic positions increases, the number of publications plays an increasingly important role in hiring and tenure decisions [Mahoney, 1976]. Studies on the value of single-author and multi-author publications give us quite different views on the issue. Some institutions penalize multiple authorship by giving more credit to single-author and first-author publications [Mahoney, 1985]. However, the total credit to all authors of jointly authored papers appears to be greater than the credit given to the authors of singly authored articles [Nudelman and Landers, 1972]. For the case of a three-author article, Nudelman and Landers [1972] found that the first author received 75% of the credit of a singly authored article while the second author received 62% and the third 58%. An interesting study by Diamond [1985] found that the money worth of a citation to a single-authored article is less to its author than a citation to a multiple-authored article. On the other hand, evidence [Bayer and Smart, 1991] suggests that those who heavily concentrated their work in non-collaborative enterprises are less likely to be successful in their career. Clearly, the number of authors and their order is an important consideration for authors designing and crafting research publications.

III. OBJECTIVES

We sought to investigate the development of authorship collaboration in information systems research, in terms of the number of researchers cooperating on IS publications and the authorship order for those publications. Specifically, we sought to investigate these questions in the time period from 1987 to the present:

1. Did the level of collaboration change substantially in IS research?
2. Was there a shift in the manner in which authorship order is determined in IS research?

IV. METHOD AND DATA

To investigate these issues, we looked at patterns of collaboration among researchers publishing in ten IS journals from 1987 through 2001. To investigate these phenomena in an IS research

culture, rather than one mixed with other, adjacent disciplines, we restricted our investigation to "pure-IS" journals, as defined by Walstrom and Hardgrave [2001]. In addition, we added *Communications of the ACM* because, even though it positions itself as a computer science magazine, it is consistently defined as a highly ranked IS journal. We considered including the Information Systems Department of *Management Science.* However, since the IS Department published an average of less than 4.5 IS articles per year during our 15 year period, we thought it unlikely that authorship issues at *Management Science* would to be much influenced by an IS research culture. In addition, the small number of IS articles published in this journal would be unlikely to affect the results of our analysis in any substantial way. With one notable exception, *ISR* because of its prominence in IS research, we included only journals that published continuously since 1985. This rule excluded several newer journals of substance, such as *CAIS*. The resulting list of ten IS journals is shown in Table 1 The table also shows the number of articles published in each for three-five year periods, starting in 1987. It is worth noting that more than one third of the articles published by all ten of these journals are published in *Communications of the ACM*. It seems likely that this imbalance reflects *CACM's* special position as a magazine published by a computer science professional society for its membership. Also, we note that about 38% more articles were published in these same ten journals in the latest five year period, compared to the earliest, an increase almost entirely attributable to an increase in the number of articles published in *CACM.*

Table 1. Journal Statistics

	Number of articles			
Journals	**1987-1991**	**1992-1996**	**1997-2001**	**TOTAL**
ACM Transactions on Information Systems	79	82	63	224
Communications of the ACM	556	862	1155	2573
DATA BASE FOR Advances in Information Systems	73	91	97	261
Decision Support Systems	145	298	326	769
Information and Management	260	289	230	779
Information Systems	203	170	138	511
Information Systems Management	278	298	246	822
*Information Systems Research**	32	93	110	235
Journal of Management Information Systems	134	170	166	470
MIS Quarterly	158	122	108	388
TOTAL	1927	2504	2668	7032

* started publishing in 1990

For each paper published in these journals from 1987 – 2001, omitting editorials, letters, and memorials, we recorded the number of authors and order of authorship. Appendix I shows the resulting data, including the number of articles and the number of articles in which authorship is ordered alphabetically, in each year, 1987 to 2001, with each of one to n authors, in each of the

journals. We used this data to perform some simple analysis to evaluate changes in the patterns of authorship and collaboration in IS research.

V. ANALYSIS AND RESULTS

First we evaluated the number of authors per article. In Figure 1 we show the percentage of articles with one, two, three and more than three authors for each year, shown as a running five year average to smooth the lines. Here we included all of the journals in Table 1, except *Communications of the ACM*. *CACM's* authorship patterns differ somewhat from the others because of its positioning as a magazine. We can see from the chart that the proportion of single-author articles decreased markedly over the 15 year period, while the proportion of three-author papers and papers with more than three authors increased. The number of papers with two authors remained about constant. Clearly multiple authorship is increasing in IS research.

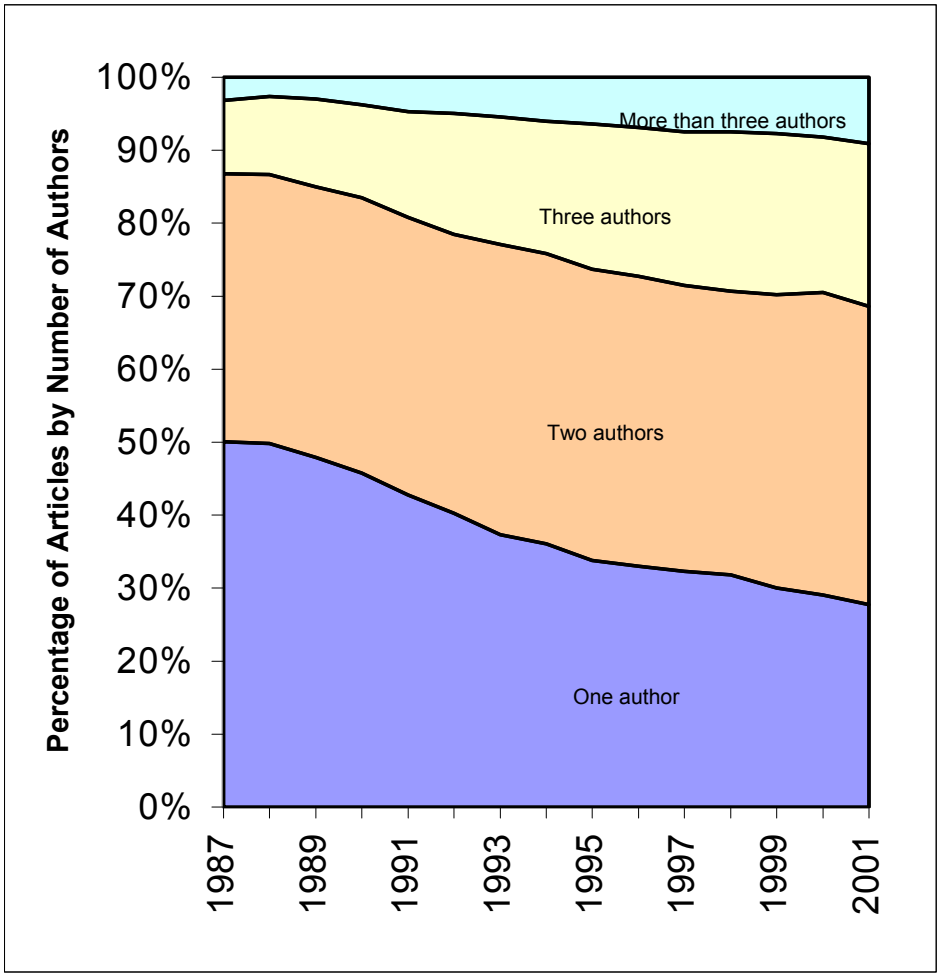


Figure 1. Percentage of one, two, three, and more than three authored papers in nine "pure-IS" journals, shown as a five year running average for 1987-2001

To evaluate this trend more rigorously we compared the number of authors for papers in two five year periods, 1987-1991 and 1997-2001 and tested the differences in proportion for statistical significance. Table 2 shows the result of this analysis. Table 2a shows the results for the nine "pure IS" journals, not including *CACM.* It shows a marked decline in the proportion of single author articles and a corresponding increase in three and more than three author articles. Two author papers remain approximately constant. The differences in one, three and more than three

authored articles from the first period to the later period is statistically significant at the .0001 level. For *CACM* (Table 2b) the story is somewhat different. A small, statistically significant difference is observed in one-authored articles and a substantial increase in three-authored papers, while two-authored and more than three authored papers remain about constant. Perhaps this data reflects the character of *CACM* as a magazine that limits the maximum lengths of articles, thereby encouraging single authorship.

Why is there an increase in multiple authorship? Is it a result of better collaboration opportunities and communication technology? Does it reflect an underlying increase in article complexity? Might it result from an increased research output from expanding PhD programs?

Table 2. Proportion and Number (in parenthesis) of One, Two, Three, and More than Three Authored Articles for Two Five Year Periods, 1987-91 and 1997-2001

a. Nine "Pure-Is" Journals (all except CACM)

Number of authors	1987-1991	1997-2001	p-value for difference in two periods
One	0.47 (897)	0.38 (1003)	0.0000
Two	0.34 (661)	0.34 (895)	0.3499
Three	0.13 (244)	0.19 (497)	0.0000
More than three	0.06 (116)	0.09 (244)	0.0000

b. *CACM*

Number of authors	1987-1991	1997-2001	p-value for difference in two periods
One	0.57 (315)	0.51 (591)	0.0166
Two	0.26 (143)	0.25 (286)	0.3343
Three	0.08 (46)	0.14 (167)	0.0001
More than three	0.09 (52)	0.10 (111)	0.4324

To determine whether the increase in multiple author papers might result from an increase in the number of articles that resulted from PhD dissertation research, we sought to identify such papers and to analyze the number of them over time. The argument for this explanation might be that such articles are very likely to be co-authored between student and advisor and, hence, more likely to be written by multiple authors. Expanding PhD programs might result, therefore, in more multiple authored papers.

Of course, articles that result from PhD research are not usually explicitly so identified. We sought to approximate such identity by defining an article as a PhD article if any of the following conditions apply:

1. It is a multiple-author paper and one of the authors is a PhD candidate and one co-author is a faculty member in the same school as the PhD candidate.
2. It is a multiple-author paper and one of the authors graduated not more than two years before the publication of the paper and one co-author is teaching in the same school from which this PhD candidate graduated.
3. It is a single-author paper. The author is a PhD candidate.
4. It is a single-author paper. The author graduated not more than 2 years before the publication of the paper.

Using this identification, we examined the number of PhD articles and the patterns of multiple authorship in two representative IS research journals, *MISQ* and *I & M.* The results of the analysis are different for the two journals. In *I & M* the proportion of PhD articles in the journal increased from 16% in the earlier period to 23% in the later period. We used chi-square tests to determine whether the distribution of authorship for the PhD articles differed from the distribution of authorship for all articles in the same journal. The tests did not show that PhD articles contained a different number of authors than other articles did in either period.

At *MISQ* we saw different results. The proportion of PhD articles actually decreased, from 16% in 1987-1991 to 10% in 1997-2001. A casual observation reveals that, in *MISQ,* almost no single authored PhD articles were published in this journal in either period. Chi-squared tests confirm that, at *MISQ*, the distribution of authorship in the PhD articles was different than for all articles. PhD articles used multiple authorship more.

Overall, the analysis suggests that PhD articles cannot account for the increase in multiple authorship. PhD articles represent a small proportion of all articles and the occurrence of multiple authorship in these articles is only slightly, if at all, more common in PhD articles than in all articles. Details of this analysis are shown in Appendix II. The lack of an observable connection between graduate student papers and multiple authorship is also observed elsewhere, [e.g., Gladding, 1984].

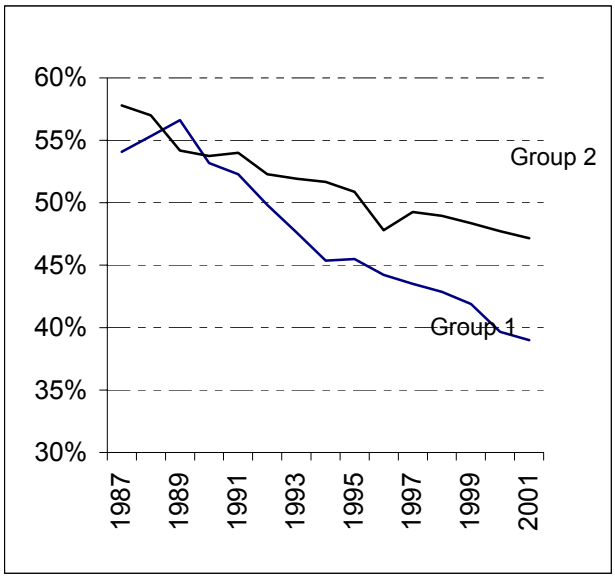
An alternate explanation is that increasing demands for article quality lead to more complex research, more easily accomplished by several researchers than by one. To determine whether increase in complexity of research projects over the years could explain some of what we observe, we sought to compare article complexity in the two periods. We used the number of pages in each article as a proxy for complexity. We counted the number of pages per article in two representative publications, the *MIS Quarterly* and *Information & Management,* for 1987 – 1991 and 1997 – 2001. Table 3 shows the mean number of pages per article for each period in each journal. The results are quite different for the two journals. For *MIS Quarterly* the increase in average article pagination is over 60% . *I & M* articles remained relatively constant in size, showing only a modest, but significant 20% increase in length. Given that *MISQ* is regarded as a leading IS research journal, while *I & M* faces competing demands for professional readability, we take these results as informal support for our argument.

Table 3. Mean Number of Pages per Article,
MIS Quarterly and *Information & Management*, 1987-1991 and 1997-2001

	MISQ	**I&M**
1987-1991	15.2	10.2
1997-2001	25.2	12.3
p-value for difference in means	0.0000	0.0000

Next we sought to ascertain whether there was a corresponding change in the patterns of order of authorship over these same 15 years. Thinking that there might be a difference in order of authorship for different classes of journals, we divided the ten journals into two groups. Group 1 are the generally top-ranked, [e.g., Mylonopoulos, 2001; Walstrom and Hardgrave, 2001], *MIS Quarterly*, *Journal of Management Information Systems*, *Information Systems Research* and *Communications of the ACM*. Group 2 includes the other six journals, *Information & Management*, *Decision Support Systems*, *Information Systems*, *Information Systems Management*, *DATA BASE for Advances in Information Systems*, and *ACM Transactions on Information Systems*. It seemed likely that when authors publish in the more prestigious Group 1 journals they might find that the greater career value of those publications make it more worthwhile to act more selfishly and to negotiate the order of authorship. To smooth the lines we used 5 year running averages. Single authored papers were not considered in calculating the proportions.

Figure 2 shows the results of this analysis. The percentage of alphabetically ordered papers in both groups decreased markedly; however, the drop is more rapid in Group 1, the more prestigious group.



Five year averages used for smoothing.
Group 1: *MISQ, ISR, JMIS,* and *CACM.*
Group 2: *I&M, IS Mgmt, DSS, ACM ToIS, IS,* and *DATA BASE*

Figure 2. Proportion of Alphabetically Ordered Authorship Articles for Group 1 and 2 journals, 1987-2001.

We considered whether more PhD articles might be the cause of a change in the proportion of alphabetically ordered author articles, as PhD students may be given first authorship for articles that result from their dissertations. To determine whether this might be the case, we compared the proportion of alphabetically ordered author articles among PhD articles and all articles in *I & M* and *MISQ* for each of 1987-1991 and 1997-2001 for each of 2, …, n authors. None of the proportions were statistically significantly different, i.e., the proportion of alphabetically author ordered articles was not different for PhD articles. We conclude that the change in the proportion of alphabetically ordered authorship is not the result of PhD articles. It seemed likely that it results from a shift in the model used among authors to determine author order, away from an alphabetical model and toward a contribution model.

We wanted to determine whether there was a change in the number of articles where authors used the alphabetical or contribution models for order of authorship. In Table 4 we compare the proportion of articles in all ten journals where authorship is alphabetically ordered for 1987-1991 and 1997-2001 and the expected proportions that would be alphabetically ordered if authors all used an alphabetic model or if authors all used a contribution model. This analysis showed that the proportion of alphabetically ordered articles decreased. The expected number of alphabetically ordered articles if all articles were ordered on contribution also changed because of the changed distribution in the number of authors in the two periods. The more authors, the smaller the chance that the order will be alphabetical by chance.

The actual number of articles with alphabetically ordered authorship is statistically significantly different than that expected if authors had all used either the contribution or the alphabetical model. It is also statistically different in the two periods. A plausible inference is that authors use a mixture of the two methods to determine authorship order, but they are moving away from the alphabetical model.

Table 4. Number of Alphabetically Ordered Articles in Ten Journals Compared with Expected Number of Alphabetically Ordered Articles if Authors were Using the Alphabetical Model or the Contribution Model,

1987-1991 vs 1997-2001

	Actual proportion alphabetically ordered author articles	**Expected if all authors used contribution model**	**Expected if all authors used alphabetical model**	**p-value for difference from contribution model**	**p-value for difference from alphabetical model**
1987-1991	0.53	0.37	1.00	0.0000	0.0000
1997-2001	0.43	0.33	1.00	0.0000	0.0000
p-value for difference between two periods	0.0000				

Using the information in Table 4, as well as the number of papers in which there are two, three, …n authors, we can use simple algebra to estimate the number of articles in which the alphabetical and contribution models were actually used by the authors to order author names. Appendix III shows the details of the calculation. The results are displayed in Table 5 for group 1, *CACM,* group 2, and for all of the journals combined. They show a marked decrease in estimated use of the alphabetic model for ordering author names among all of the journals, but particularly for the group 1 journals, where alphabetic ordering has all but disappeared, and for *CACM,* where the estimated use of the alphabetical model was reduced by more than half.

Table 5. Estimated Proportion of Papers Using the Alphabetical Model to Order Author Names

	Group 1*	**CACM**	**Group 2**	**Combined**
1987-1991	0.286	0.252	0.252	0.260
1997-2001	0.091	0.120	0.202	0.152

* Excluding *CACM*, including *MISQ*, *ISR*, and *JMIS*.

VI. DISCUSSION

The patterns of collaborative authorship in information systems experienced a major shift in the last 15 years.. The number of multiple author papers in IS research is significantly greater than it was 15 years ago. Research collaboration went from being something that was done in a minority of projects to the community norm for IS. At the same time, for multiple authored papers, a marked shift away from alphabetical listing by surname occurred as a model for ordering authors. Why has there been the change?

Several plausible reasons come to mind to explain the trend toward multiple authorship.

1. A general trend toward multiple authorship across all disciplines. In disciplines with longer histories, the change is even more marked than in our own and it occurred earlier. For example, in the *Journal of Counseling Psychology*, multiple authored articles went from 19.6% in 1954 to 76.7% in 1979 [Strahan, 1982].
2. Better communication among geographically dispersed authors. Fifteen years ago, IS researchers used e-mail accounts; however, even if a paper was composed on a word processor (not always), transferring word processing files was a tedious, uncertain process, often accomplished by sending diskettes through the regular mail and the loss of painstakingly created formatting.
3. Credit accruing to multiple authors appears to be greater than for single authors, as colleagues, tenure committees, and other constituents fail to fully discount authorship credit for the number of authors.
4. There complexity of research appears to be increasing, as evidenced by the trend toward longer papers, such that researchers may now think that collaboration is a necessity to produce relevant and widely appreciated research [Sacco and Milana, 1984]. In other disciplines the more prestigious journals contain more collaborative papers [Beaver and Rosen, 1979] and a paper with multiple authors is more likely to be accepted for publication [Gordon, 1980; Presser, 1980].

   In our own discipline, *MISQ's* paper of the year for 2001 is 62 pages long [Te'eni, 2001]. By comparison and at the other extreme White and Christy's [1987] paper, proposing a normative model for information centers, and Wrightman's [1990] loyalty program case study (with five citations), are each 7 ½ pages long. A cursory comparison of the three papers suggests that the current publishing culture sets a much higher mark for grounding theoretical papers in prior and, possibly cross disciplinary, literature. Could White and Christy's [1987] paper or Wrightman's [1990] case study be published today (presuming that they still said something that was new today)? Perhaps not, at least in their brief form.

The near disappearance of the alphabetical model for order of authorship is a little more difficult to explain. Perhaps, as papers become more complex and require more resources to produce, it becomes more important for researchers to squeeze out the maximum credit from each publication. Alternatively, it may reflect a general trend toward more selfish behavior among IS researchers with the more powerful researcher exercising leverage for his or her advantage or it might reflect researcher response to an increasingly competitive research requirement in IS. In addition, as multiple authorship becomes more common, citation styles that list only the first author on multiple authored papers, punish the second, third and fourth authors, thus creating an incentive for co-authors to scramble out from behind their colleagues with surnames that begin with letters near the beginning of the alphabet.

If authorship in IS research is ordered by contribution, there is almost no disciplinary guidance for how to arrange the order. Do we require guidelines like those of the APA [American Psychological Association 2002]? Their guidelines are not detailed. They merely require that authors made substantial contribution to the work and not achieve authorship by rank or position

and that principal authorship reflect the primary contribution to the paper. They also set an expectation that a student is usually the first author for work arising from a dissertation.

An alternative or complement to an ethical standard for contribution credit is disclosure. Papers could carry a disclosure that describes the contributions to the paper of each author. In addition, perhaps IS journals should use citation styles that show all authors for multiple authored papers, rather than using "et. al." For electronic journals, such as *CAIS*, this expansion would cost little. Whatever the mechanism, it may now be time that we formalize a standard for authorship credit in IS research, rather than leaving it to the more powerful member of the research team.

DISCLOSURE: AUTHOR ROLES IN THIS PAPER

In keeping with our recommendation for making contributions public, we define the contribujtions of the authors of this article. Ken Peffers conceived of and took primary responsibility for planning the project, analysis, and paper, wrote the finished draft, and handled correspondence with the editor. Wendy Hui located and wrote an initial report about relevant prior research, collected data, determined the detailed analysis methodology, carried out the analysis, and prepared an initial draft paper. The authors agreed that Dr. Peffers would be first author on this paper and that Ms Hui would be the first author on a subsequent, in progress, paper.

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APPENDIX I. DATA

DATA ON MULTIPLE AUTHORSHIP

The following ten tables show the number of articles with each of one to 21 authors in ten information systems research journals. The data are given by year, from 1987 through 2001. Columns with all zero observations are not shown.

ACM Transactions on Information Systems									
# authors / Year	1	2	3	4	5	6	7	8	12
1987	2	10	1	1	2	0	1	0	1
1988	9	4	3	2	0	0	0	0	0
1989	4	6	3	1	0	2	0	0	0
1990	4	7	2	1	1	0	0	0	0
1991	1	5	3	3	0	0	0	0	0
1992	2	6	5	2	0	0	1	0	0
1993	3	6	5	3	0	0	0	0	0
1994	3	11	2	0	0	0	0	0	0
1995	5	7	6	0	0	0	0	0	0
1996	2	10	2	1	0	0	0	0	0
1997	4	6	2	0	1	1	0	0	0
1998	2	5	2	1	0	0	0	0	0
1999	1	8	2	2	0	0	0	0	0
2000	1	6	3	1	0	0	0	1	0
2001	0	3	5	6	0	0	0	0	0

Communications of the ACM													
# authors / Year	1	2	3	4	5	6	7	8	9	10	11	16	21
1987	48	26	8	5	3	1	0	0	1	0	0	0	0
1988	62	31	11	7	3	1	0	0	0	0	0	0	0
1989	56	38	5	4	2	2	1	1	0	0	0	0	0
1990	71	25	10	5	6	1	0	0	0	0	0	0	0
1991	78	23	12	5	3	0	0	0	1	0	0	0	0
1992	77	30	16	7	5	2	1	1	0	0	0	1	0
1993	105	34	15	9	6	0	1	1	0	0	0	0	1
1994	85	35	24	10	4	0	0	1	0	1	0	0	0
1995	94	60	16	14	3	1	1	2	0	0	1	0	0
1996	106	42	26	14	4	3	0	1	2	0	0	0	0
1997	122	51	32	10	4	3	0	0	1	1	0	0	0
1998	111	56	33	13	5	5	1	1	0	0	0	0	0
1999	111	54	31	7	5	0	0	2	0	0	0	0	0
2000	96	66	43	11	4	4	2	0	1	2	0	0	0
2001	151	59	28	15	6	5	1	0	0	0	2	0	0

DATA BASE for Advances in Information Systems						
# authors / Year	1	2	3	4	5	6
1987	4	6	1	1	0	0
1988	9	4	2	1	0	0
1989	9	11	5	0	0	0
1990	3	4	1	0	1	0
1991	4	6	1	0	0	0
1992	6	10	3	1	0	0
1993	3	6	1	1	0	0
1994	8	4	6	0	0	1
1995	4	6	2	0	0	0
1996	16	9	3	1	0	0
1997	6	9	1	1	1	0
1998	10	9	5	0	0	0
1999	6	8	5	1	0	0
2000	3	9	3	1	0	0
2001	7	9	3	0	0	0

Decision Support Systems							
# authors / Year	1	2	3	4	5	6	9
1987	17	7	2	0	0	0	0
1988	17	14	6	1	0	0	0
1989	9	11	7	0	1	1	0
1990	10	10	3	0	0	0	0
1991	9	13	5	2	0	0	0
1992	12	12	10	2	0	0	0
1993	17	23	7	4	0	0	0
1994	20	24	15	6	1	0	0
1995	15	33	21	6	0	0	0
1996	14	32	15	6	3	0	0
1997	22	18	22	2	1	0	0
1998	22	30	18	4	1	1	0
1999	12	22	12	6	2	0	1
2000	10	34	19	5	3	2	0
2001	15	19	15	6	0	2	0

Information and Management							
# authors / Year	1	2	3	4	5	6	7
1987	12	29	5	1	0	0	0
1988	23	25	5	0	0	0	0
1989	21	19	8	2	0	0	0
1990	19	27	7	1	1	0	0
1991	17	27	9	2	0	0	0
1992	18	29	12	0	0	1	0
1993	20	28	10	2	0	0	0
1994	7	15	5	2	1	0	0
1995	23	22	13	3	0	0	0
1996	18	33	21	5	1	0	0
1997	10	21	7	3	1	0	0
1998	10	27	9	2	0	0	0
1999	11	26	12	2	1	0	1
2000	9	31	11	3	0	0	0
2001	5	17	9	2	0	0	0

Information Systems								
# authors / Year	1	2	3	4	5	6	7	8
1987	20	6	8	0	1	0	0	0
1988	13	14	3	0	1	0	0	0
1989	13	16	11	4	0	0	0	0
1990	21	18	12	1	1	0	0	0
1991	9	15	13	2	0	1	0	0
1992	7	18	5	1	0	0	0	0
1993	13	17	8	1	0	0	0	0
1994	11	9	9	7	0	1	1	0
1995	2	12	13	2	0	3	0	0
1996	9	14	4	0	2	1	0	0
1997	2	10	8	3	0	0	0	0
1998	6	14	7	1	1	0	0	0
1999	5	8	8	6	2	1	0	0
2000	3	14	9	2	0	0	0	0
2001	2	8	12	4	1	0	0	1

Information Systems Management					
# authors / Year	1	2	3	4	5
1987	51	8	0	0	0
1988	51	8	2	0	0
1989	37	13	1	2	0
1990	38	6	6	0	0
1991	45	10	0	0	0
1992	46	12	3	1	0
1993	42	13	3	0	0
1994	45	8	6	1	0
1995	38	16	5	1	0
1996	39	12	7	0	0
1997	39	15	5	1	0
1998	38	12	4	0	0
1999	25	16	7	0	0
2000	32	9	2	3	0
2001	27	7	2	1	1

Information Systems Research						
# authors / Year	1	2	3	4	5	6
1987	--	--	--	--	--	--
1988	--	--	--	--	--	--
1989	--	--	--	--	--	--
1990	5	13	1	1	0	0
1991	1	9	2	0	0	0
1992	1	11	4	0	0	0
1993	1	8	3	1	0	0
1994	2	13	2	2	0	1
1995	2	9	4	1	0	0
1996	9	14	3	2	0	0
1997	6	6	6	1	1	1
1998	3	11	6	1	0	0
1999	2	14	3	2	1	0
2000	2	13	8	1	0	0
2001	5	8	6	3	0	0

Journal of Management Information Systems						
# authors / Year	1	2	3	4	5	6
1987	6	14	3	1	0	0
1988	8	14	4	0	1	1
1989	7	12	5	2	1	0
1990	4	12	7	1	1	0
1991	9	12	7	2	0	0
1992	7	12	11	4	0	0
1993	3	20	8	2	0	0
1994	4	16	9	4	0	0
1995	5	14	10	4	2	0
1996	8	10	13	2	2	0
1997	3	18	11	3	2	0
1998	5	12	10	2	0	1
1999	8	18	7	1	0	2
2000	11	14	8	3	0	0
2001	3	15	7	2	0	0

MIS Quarterly						
# authors / Year	1	2	3	4	5	6
1987	8	20	6	1	0	0
1988	7	18	10	0	1	0
1989	11	13	4	1	1	0
1990	8	9	6	2	1	1
1991	7	13	8	2	0	0
1992	6	11	10	3	0	0
1993	3	14	7	2	0	0
1994	4	12	5	1	0	0
1995	3	10	10	0	0	1
1996	6	9	4	1	0	0
1997	0	8	9	2	0	0
1998	3	12	4	1	0	0
1999	6	12	6	2	0	0
2000	6	11	5	2	1	1
2001	4	7	5	1	0	0

DATA ON ALPAHBETICAL ORDER OF AUTHORSHIP

The following ten tables show the number of articles with alphabetically ordered authorship, with each of two to 21 authors in ten information systems research journals The dta are given by year, from 1987 through 2001. Articles with one author are excluded.

ACM Transactions on Information Systems									
# authors / Year	1	2	3	4	5	6	7	8	12
1987	--	8	0	0	1	0	0	0	0
1988	--	2	2	1	0	0	0	0	0
1989	--	4	0	0	0	0	0	0	0
1990	--	4	0	0	0	0	0	0	0
1991	--	1	2	2	0	0	0	0	0
1992	--	2	3	0	0	0	0	0	0
1993	--	5	2	0	0	0	0	0	0
1994	--	4	2	0	0	0	0	0	0
1995	--	4	1	0	0	0	0	0	0
1996	--	9	0	0	0	0	0	0	0
1997	--	4	1	0	0	0	0	0	0
1998	--	2	1	1	0	0	0	0	0
1999	--	6	1	0	0	0	0	0	0
2000	--	5	1	0	0	0	0	0	0
2001	--	3	2	0	0	0	0	0	0

Communications of the ACM													
# authors / Year	1	2	3	4	5	6	7	8	9	10	11	16	21
1987	--	22	2	0	0	0	0	0	0	0	0	0	0
1988	--	18	7	1	1	0	0	0	0	0	0	0	0
1989	--	25	3	0	0	1	0	1	0	0	0	0	0
1990	--	11	3	0	0	1	0	0	0	0	0	0	0
1991	--	13	5	1	1	0	0	0	0	0	0	0	0
1992	--	17	8	0	0	0	0	0	0	0	0	0	0
1993	--	22	5	0	0	0	0	0	0	0	0	0	1
1994	--	21	7	1	1	0	0	0	0	0	0	0	0
1995	--	39	6	1	1	1	0	0	0	0	0	0	0
1996	--	21	14	1	1	2	0	0	0	0	0	0	0
1997	--	33	6	1	1	1	0	0	0	0	0	0	0
1998	--	34	5	1	1	0	0	1	0	0	0	0	0
1999	--	29	9	0	0	0	0	0	0	0	0	0	0
2000	--	28	15	1	1	0	1	0	0	0	0	0	0
2001	--	31	9	0	0	0	0	0	0	0	0	0	0

DATA BASE for Advances in Information Systems						
# authors / Year	1	2	3	4	5	6
1987	--	1	0	0	0	0
1988	--	3	2	0	0	0
1989	--	7	2	0	0	0
1990	--	2	1	0	0	0
1991	--	4	1	0	0	0
1992	--	5	1	0	0	0
1993	--	4	1	0	0	0
1994	--	3	0	0	0	0
1995	--	2	0	0	0	0
1996	--	3	0	0	0	0
1997	--	6	0	0	0	0
1998	--	7	4	0	0	0
1999	--	4	1	0	0	0
2000	--	5	2	0	0	0
2001	--	8	0	0	0	0

Decision Support Systems							
# authors / Year	1	2	3	4	5	6	9
1987	--	4	1	0	0	0	0
1988	--	10	4	0	0	0	0
1989	--	2	3	0	1	0	0
1990	--	6	0	0	0	0	0
1991	--	9	4	0	0	0	0
1992	--	11	5	0	0	0	0
1993	--	16	3	1	0	0	0
1994	--	18	4	3	0	0	0
1995	--	23	7	2	0	0	0
1996	--	23	6	1	0	0	0
1997	--	10	8	1	0	0	0
1998	--	19	4	1	1	0	0
1999	--	13	3	0	1	0	0
2000	--	13	5	1	0	0	0
2001	--	9	5	3	0	0	0

Information and Management							
# authors / Year	1	2	3	4	5	6	7
1987	--	19	0	1	0	0	0
1988	--	14	2	0	0	0	0
1989	--	12	1	1	0	0	0
1990	--	16	4	1	0	0	0
1991	--	19	3	1	0	0	0
1992	--	16	4	0	0	0	0
1993	--	16	3	2	0	0	0
1994	--	5	2	1	0	0	0
1995	--	10	3	0	0	0	0
1996	--	16	7	0	0	0	0
1997	--	15	2	1	0	0	0
1998	--	17	3	1	0	0	0
1999	--	19	2	0	1	0	0
2000	--	16	5	0	0	0	0
2001	--	10	1	1	0	0	0

Information Systems								
# authors / Year	1	2	3	4	5	6	7	8
1987	--	5	4	0	1	0	0	0
1988	--	8	1	0	1	0	0	0
1989	--	13	4	2	0	0	0	0
1990	--	9	3	0	0	0	0	0
1991	--	12	7	0	0	1	0	0
1992	--	6	2	0	0	0	0	0
1993	--	8	4	0	0	0	0	0
1994	--	4	5	3	0	1	0	0
1995	--	5	4	1	0	1	0	0
1996	--	10	2	0	0	0	0	0
1997	--	8	4	2	0	0	0	0
1998	--	6	3	1	0	0	0	0
1999	--	5	5	3	0	1	0	0
2000	--	8	2	0	0	0	0	0
2001	--	5	2	1	0	0	0	0

Information Systems Management					
# authors / Year	1	2	3	4	5
1987	--	7	0	0	0
1988	--	3	1	0	0
1989	--	7	1	0	0
1990	--	4	2	0	0
1991	--	6	0	0	0
1992	--	7	2	0	0
1993	--	9	2	0	0
1994	--	4	5	0	0
1995	--	11	0	0	0
1996	--	4	3	0	0
1997	--	11	2	1	0
1998	--	9	2	0	0
1999	--	6	0	0	0
2000	--	5	0	1	0
2001	--	6	2	0	0

Information Systems Research						
# authors / Year	1	2	3	4	5	6
1987	--	--	--	--	--	--
1988	--	--	--	--	--	--
1989	--	--	--	--	--	--
1990	--	8	0	0	0	0
1991	--	4	0	0	0	0
1992	--	5	2	0	0	0
1993	--	3	1	0	0	0
1994	--	10	1	0	0	0
1995	--	7	1	0	0	0
1996	--	5	2	0	0	0
1997	--	4	2	0	0	0
1998	--	5	2	0	0	0
1999	--	7	1	0	0	0
2000	--	7	2	0	0	0
2001	--	4	2	1	0	0

Journal of Management Information Systems						
# authors / Year	1	2	3	4	5	6
1987	--	9	2	1	0	0
1988	--	7	1	0	0	0
1989	--	9	1	0	0	0
1990	--	11	2	1	0	0
1991	--	9	3	0	0	0
1992	--	8	0	3	0	0
1993	--	7	5	1	0	0
1994	--	7	2	3	0	0
1995	--	9	4	2	0	0
1996	--	4	7	0	1	0
1997	--	8	5	0	0	0
1998	--	8	2	0	0	0
1999	--	9	0	0	0	1
2000	--	8	2	1	0	0
2001	--	11	4	0	0	0

MIS Quarterly						
# authors / Year	1	2	3	4	5	6
1987	--	10	3	1	0	0
1988	--	14	3	0	1	0
1989	--	10	3	0	0	0
1990	--	3	2	1	0	1
1991	--	10	3	0	0	0
1992	--	7	4	1	0	0
1993	--	8	4	0	0	0
1994	--	7	1	0	0	0
1995	--	4	0	0	0	1
1996	--	4	2	0	0	0
1997	--	4	2	0	0	0
1998	--	6	2	1	0	0
1999	--	7	2	0	0	0
2000	--	3	1	0	0	0
2001	--	3	2	0	0	0

APPENDIX II. ORDER OF AUTHORSHIP OF PHD ARTICLES

We examined articles published in *Information and Management* and *MIS Quarterly* to determine whether the publication of articles resulting from PhD research can explain the increase in the number of multiple authored articles. To identify PhD articles we defined a paper as a PhD article, i.e., results from PhD research, if any of the following conditions apply:

1. It is a multiple-author paper and one of the authors is a PhD candidate and one co-author is a faculty member in the same school as the PhD candidate.
2. It is a multiple-author paper and one of the authors graduated not more than two years before the publication of the paper and one co-author is teaching in the same school from which this PhD candidate graduated.
3. It is a single-author paper. The author is a PhD candidate.
4. It is a single-author paper. The author graduated not more than 2 years before the publication of the paper.

INFORMATION AND MANAGEMENT

In the period 1987-1991, PhD papers accounted for 14% of all published papers in this journal. This percentage increased to 23% for the period 1997-2001.

Table A1 shows the number of articles published in *I & M* for 1987-2001 by number of authors, the proportion of articles with each number of authors, and the number of PhD articles, estimated using the above definition. We used a chi-square test to determine whether the distribution of the PhD articles by number of authors is different than the distribution of all papers. The test does not show that these distributions are statistically significantly different. In other words, it does not provide evidence that PhD student research is more likely to result in multiple authored papers.

Table A1. Number of Articles Published in *I & M* (1987-1991) by Number of Authors, Proportion of articles with Each Number of authors, and Number of PhD articles.

# authors	Total articles	Prop.	PhD articles	p-value
1	92	0.35	11	
2	127	0.49	15	
3	34	0.13	7	
4	6	0.02	3	
5	1	0.00	0	
total	260	1.00	36	**0.1837**

X^2 test for difference in distributions.

We performed the same test for the period 1997-2001, shown in Table A2. Again, the test does not provide evidence of a difference between the two distributions, even though the proportion of PhD papers has increased.

Table A2. Number of Articles Published in *I & M* (1987-1991) by Number of Authors, Proportion of Articles with Each Number of authors, and Number of PhD Articles.

# authors	Total articles	Prop.	PhD articles	p-value
1	45	0.20	14	
2	122	0.53	26	
3	48	0.21	8	
4	12	0.05	3	
5	2	0.01	1	
7	1	0.00	1	
total	230	1.00	53	**0.4818**

X^2 test for difference in distributions.

MIS QUARTERLY

PhD articles accounted for 16% of all published papers in the period 1987-1991. This figure dropped to 10% in the period 1997-2001. The chi-squared test suggests that for both periods the distribution of PhD articles among number of authors is different than for all papers published in this journal. Observation suggests that this is because among the PhD articles almost none are single authored. The data are shown in Tables A3 and A4.

Table A3. Number of Articles Published in *MISQ* (1987-1991) by Number of Authors, Proportion of Articles with Each Number of Authors, and Number of PhD articles.

# authors	Total articles	Proportion	PhD articles	p-value
1	41	0.26	2	
2	73	0.46	9	
3	34	0.22	11	
4	6	0.04	1	
5	3	0.02	2	
6	1	0.01	1	
total	158	1.00	26	**0.0059**

X^2 test for difference in distributions.

Table A4. Number of Articles Published in *MISQ* (1987-1991) by Number of Authors, Proportion of Articles With Each Number of Authors, and Number of PhD articles.

# authors	Total articles	Proportion	PhD articles	p-value
1	19	0.18	1	
2	50	0.46	2	
3	29	0.27	3	
4	8	0.07	4	
5	1	0.01	1	
6	1	0.01	0	
total	108	1.00	11	**0.0009**

X^2 test for difference in distributions.

APPENDIX III. CALCULATING THE PROPORTION OF PAPERS ASSIGNING ORDER OF AUTHORSHIP ALPHABTICALLY

This calculation requires knowing the number of authors for each paper published by the journal in the indicated period, so that N_n can be calculated.

Let x_n be the number of papers using the contribution model to order authorship in all n-author papers, regardless of whether authors are actually alphabetically ordered in the paper or not

y_n be the total number of n-author papers alphabetically ordered, regardless of whether they are using the contribution or alphabetical model to order authors

N_n be the total number of n-author papers

p_n be the probability that order of authorship based on contribution is actually alphabetical. This probability depends on the number of authors on the paper, as the probability that author order is alphabetical is 1/n!.

The number of papers using the alphabetical model = $N_n - x_n$

The total number of n-author papers in which the author names are alphabetically ordered is equal to

(1) the number of n-author papers using the contribution model *that are* alphabetically ordered plus

(2) the number of papers using the alphabetical model, i.e.,

$y_n = x_n p_n + N_n - x_n$

Rearrange to get $x_n = (N_n – y_n)/(1 – p_n)$

This x_n is computed for papers with two up to twelve authors (the highest number of authors per article recorded in the periods studied).

The proportion of papers using the contribution model is the sum of all x_n divided by the total number of papers, i.e, $\sum_{n=1}^{12} x_n \Big/ \sum_{n=1}^{12} N_n$

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