The Impact of Gender on Citations: An Analysis of *College & Research Libraries, Journal of Academic Librarianship,* and *Library Quarterly*

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Three scholarly core journals of library and information science (LIS) were analyzed with respect to gender of article authors and gender of authors cited in these articles. The share of female contributors to these journals has certainly increased during the studied period, 1980–2000. However, the results of the quantitative citation analysis show puzzling differences concerning female and male authors' citation practice. There may be a gender bias in LIS publishing, even though female authors have become more numerous. Further studies are needed to uncover the influence of other variables, such as subject content of the articles.



any bibliometric studies of LIS literature in the past three decades show that the share of female authors is increas-

ing.¹ In light of the fact that women have outnumbered men in librarianship for almost a century, this is a natural, but belated, development. Is this trend a sign of gender equalization in LIS publishing? And is research produced by women being used in articles published in core journals of the field? One way to explore this is to take a closer look at the reference lists of LIS core journal articles.

Because of several studies of underrepresentation of women in social science research, Elisabeth Davenport and Herbert Snyder investigated authorship and citations in sociological core journals from the period 1985–1994.² They used a quantitative citation analysis method created by Marianne Ferber, with the purpose of examining the importance of gender in the citation process.³ They found that female researchers in sociology were underrepresented as authors, but women also received a proportionally smaller share of the citations in the discipline. Even though they may not be underrepresented in terms of authorship today, do female LIS authors receive their fair share of citations?

For the present article, the author has collected references and citation data between 1980 and 2000 from three LIS core journals: *College & Research Libraries* (*C&RL*), *Journal of Academic Librarianship* (*JAL*), and *Library Quarterly* (*LQ*). The

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data have been analyzed to answer the following questions:

1. Does gender seem to affect female and male authors' choice of references in *C&RL*, *JAL*, and *LQ* between 1980 and 2000?

2. Does gender seem to affect the share of citations that publications by women and men receive respectively in *C&RL*, *JAL*, and *LQ* between 1980 and 2000?

Both questions deal with the citation process, with the author choosing the references as the active party and the author of the cited publication as a passive recipient of a citation. The reason why the process is divided into two parts in this article is that the method used focuses on the authors that refer (the references) and the cited authors (the citations) one by one. The two perspectives are different and thus can be treated separately using different terms.

The Meaning of References and Citations

Quantitative citation analyses, one of several methodological groups of bibliometrics, are used to map out different aspects of formal scientific communication (i.e., social and/or knowledge structures). They also are used for evaluative purposes in collection management and in science and technology policies. Citation analyses have many fields of application because the phenomena of references and citations belong to both the social and the cognitive systems of science.⁴ There are several ways to interpret citation analyses. For example, in different studies high levels of citations to a scientific publication have been interpreted as signs of scientific quality, importance, relevance, utility, influence, impact, and visibility, concepts with different meaning and consequenses.⁵ Still, there is not one uniform, satisfying answer as to why researchers refer to and/or are cited and what references and citations stand for.6

In this study, the focus lies on science as a social system. Therefore, three theoreti-

cal models of the meaning of references and citations with connections to social aspects are related below: the reward system, the rhetorical system, and the communication system.

In the 1940s, Robert K. Merton introduced the theory of references and citations as the currency of the reward system of science. Suggesting science to be an economical exchange system, he argued that the reference lists of scientific articles are the authors' way of paying intellectual debts. Merton also spoke of the Matthew effect, or the accumulative advantage, a mechanism for social stratification in science. The Matthew effect means that researchers of high scientific status receive acknowledgment almost automatically, whereas the not-yet-established researcher has a high threshold to get across in order to reach recognition. The Mertonian understanding of citations is still very widely spread within bibliometrics and, with some modifications, it is in fact the theoretical foundation of evaluation of science in science and technology policies.7

The theories of references as rhetoric are heterogeneous, but they have in common the claim that researchers have subjective and strategic motives for choosing certain references over others. The mainstream of this perspective suggests that references first of all are tools of persuasion; they are used to substantiate one's research and to establish a position within the society of science.8 This does not mean that reference analyses lack usability when examining social and/or cognitive structures. Harriet Zuckerman argued that: "Even if the well-known work of a well-known scientist is cited in order to persuade ..., work 'regarded as important and correct' is presumably persuasive Sociologists need not be reminded that motives and consequences are analytically distinct."9

In the communication system, references and citations are viewed as dependant on the scientific networks and information channels researchers have access to. The possibility to receive information

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of other research or attract attention to one's own may vary due to, for example, characteristics of the journal a researcher publishes in: its language, degree of specialization, and status in the field.¹⁰

None of these three systems can alone explain the importance of references and citations on social structures in scientific communication. Susan E. Cozzens has suggested that the rhetorical system provides the necessary conditions for the referring process, with the mechanisms of the reward system coming second.11 Terttu Luukkonen has proposed that all three systems have an equal share in the explanation of reference practices. Where the rhetorical system creates the fundamental principles, the reward system provides motivation and the communication system sets the restrictions for what authors and publications are used in references.12 Even if the three systems in some parts may seem contradictory, they complement each other.

Review of Related Research

There are many examples of bibliometric studies of LIS publications. A search in ISI's Social Science Citation Index, limiting publication years to 1980-2004, returns more than 150 genuine articles.13 Several are concerned with different aspects of authorship, including gender, but there is a lack of reference and citation analyses that relate to gender. However, there are a few such studies from other disciplines. Ferber examined to what extent female and male authors referred to publications by women and men respectively during a one-year-period (1982-1983) in the field of labor economics.¹⁴ A few years later, she repeated her method on a larger sample of data from developmental psychology, sociology, financial economics, and mathematics.15 Davenport and Snyder used a modified version of Ferber's method when they analyzed a sample of reference data from ten years' publishing in twentyfive sociology core journals.16

Ferber's hypothesis is that women are at a disadvantage in accumulating citations in scientific fields where they make up a minority.¹⁷ As citations give visibility to and acceptance of research results, the consequence of such a disadvantage is that women will have problems establishing themselves as researchers. By receiving lower citation counts, the impact of female researchers on science will be less than deserved.¹⁸

To try her hypothesis, Ferber examined whether authors refer to other authors of the same gender to a higher extent than to authors of the opposite gender. By putting the question this way, she did *not* investigate whether publications by women are cited as often as publications by men but, rather, whether *publications by women are cited as often by men as by women*. In this way, she did not need to take into consideration whether the amount of citations to publications by women and men, respectively, are relative to their number and quality. These two factors are very difficult, if not impossible, to account for.¹⁹

Ferber found differences between the reference lists of articles written by women and by men. Both female and male authors refer much more often to publications by men. This is reasonable considering that just until recent decades, few of the publishing researchers have been women. Therefore, of the "referable" publications in the discipline, men have written the majority. Nevertheless, Ferber found that female authors refer to publications by women to a larger extent than male authors do. She concluded that gender plays an important part in the referring process. This implies that the shares of female and male authors at any given point, determine the shares of references given to publications by women and men, respectively.²⁰

The result could be questioned if differences in reference patterns depended on women and men writing about different subjects within the discipline. To eliminate the suspicion, Ferber repeated the method on a smaller sample of articles that deal with sex discrimination, a publication field with more female than male authors. If the unequal shares of references to publications by women and men depended on the fact that female and male authors are engaged in different subject areas within the main discipline, the share of references to publications by women should have exceeded the share of references to publications by men in this sample. But this was not the case. Even though the authors of this sample of articles refer to a slightly larger share of publications by women than in the first sample, the majority of the references were given to publications by men. Thus, the pattern was the same.²¹

Even if LIS subject areas might seem to be gender neutral, they are not. Lois Buttlar studied different aspects of authorship in sixteen LIS journals over a period of two and a half years (1987-1989). She indexed all articles by subject and found that men had written most of the articles about document retrieval, library history, and international librarianship and that women had written most of the articles about children's and young adults' services, bibliographic instruction, and library standards. However, Buttlar did not study if and how this affected the distribution of references to publications by women and men, respectively.22

When Ferber compared the results from her first study to a wider selection of disciplines in a second study, she found the same pattern. However, the share of references to publications by women varied among the different disciplines and seemed to be related to the share of women published. Ferber argued that the importance of gender in the reference practice decreases when the numbers of female and male authors become more equal.23 Ferber might have jumped to conclusions here. It is impossible to distinguish between the consequences of a decreasing importance of gender and of the increase of referable publications by women. The latter ought to enhance the likelihood of male authors finding and using publications by female authors. Concerning gender bias, there might be other processes to look at.

Davenport and Snyder applied Ferber's method to a larger selection of data and a longer period of time (1985–1994) and arrived at similar results. They argued that female authors are underrepresented in all reference lists and not just in those of articles by men. This conclusion is based on results showing that the share of references to publications by women is not proportional to the share of female authors during the period. As their material covers ten years, they suggested that they corrected for the delay between the publishing of an article and the emergence of references to the article.²⁴ Doubts might be raised as to whether they actually made up for this source of error. The amount of referable publications ought to come from a wider scope of time and subject fields than their selected material. However, Davenport and Snyder's results are still interesting because they confirm Ferber's findings.

Method and Data

According to the assumption that publishing in a scholarly core journal brings more recognition to an author than publishing in a more specialized journal, all articles of a set of LIS core journals were examined. To discern the development of referring and citation practices concerning gender, a twenty-one–year publication period (1980–2000) was chosen.

The journals in the sample had to:

• Be scholarly core journals of LIS, included in the lists of ISI's Journal Citation Reports (JCR) during 1997 and 2000

• Have the first names of all article authors spelled out, as well as the first names of the cited authors (in order to be able to determine their gender)

• Be published continuously between 1980 and 2000

Five journals in the Information and Library Science category of JCR met the demands. The three with the highest JCR impact factors were chosen: *College & Research Libraries, Journal of Academic Librarianship,* and *Library Quarterly.* In order to include the majority of the texts of these journals in this study, Bluma Peritz's wide definition of the research concept was used: "Research is any inquiry which is carried out, at least to some degree, by a systematic method with the purpose of eliciting some new facts, concepts or ideas."²⁵ Therefore, every text called article, research article, research notes, and review article were included.

The articles were divided into three categories: (1) one or more female and no male authors; (2) one or more female and one or more male authors; and (3) one or more male and no female authors. The gender of every author was noted regardless of whether they were single authors or coauthors. Davenport and Snyder only noted gender of first authors. This data-collecting method is based on the presumption in science that coauthors are ordered by their respective contributions to the research (i.e., the first author is the most important contributor). According to Martha A. Harsanyi's review of the literature on coauthorship, there is no consensus about this among researchers or publishers, even if recommendations do exist in some journals and/or subject fields.²⁶

The references also were divided into three categories: (1) references to publications by female and no male authors; (2) references to publications by one or more female and one or more male authors; and (3) references to publications by one or more male and no female authors. The number of self-citations and the number of references to publications where the gender of one or more authors was not possible to determine by this author also were recorded but are not included in the figures below.

All the references to publications with one or more authors were recorded. A publication that was referred to several times within the same article was recorded only once. This procedure is established in reference analyses on aggregate levels, despite the fact that the publication might be more important for the article than others that have only been referred to once. Authors who are represented by different publications in the same reference list were recorded once per publication. Publications that did not have personal authors, references to oral communications, interviews, telephone conversations, or informal written communications such as e-mails, questionnaires, and personal letters (unless the letters are part of a public archive) were not recorded. All reference lists were checked a second time to avoid miscalculation.

Due to the lack of quantitative citation studies relating to gender, the present study used this rather simple, but tested, count method to explore whether gender might have an influence on LIS publishing. If the results indicate gender bias, this may be a starting point for other studies using more sophisticated statistical methods and more variables. For example, the subject content of the articles and the different contexts in which references are used in the articles would be interesting to relate to gender.

Results

Authorship

The collected data allow for an authorship analysis. They are included in the results as comparison to the other figures. The number of articles totaled 1,739: 662 (38%) by female authors, 303 (17%) by female and male authors, and 774 (44%) by male authors. The average number of articles per year was eighty-three. The number of articles per year was approximately invariable during the period. (See figure 1.)

Reference Analysis

Below, the analyses that answer the first question are related: Does gender seem to affect female and male authors' choice of references in *C&RL*, *JAL*, and *LQ* between 1980 and 2000?

The total sum of references is 29,445. Of these, 7,945 (27%) references are to publications by women, 2,677 (9%) to publications by women and men, and 17,357 (59%) to publications by men. The amount of references increases year by year during the period, from slightly more than

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850 (1980) to about 1,800 (2000). A total of 1,021 (3%) of the reference records are selfcitations, and 465 (2%) are to publications by authors whose gender is unknown to the author. The graphs that would have shown the references to publications coauthored by women and men are not included in figures 2 through 4 because they do not answer the question above. This is why the sum of the graphs in the figures does not amount to 100 percent.

The reference lists in articles by female authors contain 10,794 records. Of these, 3,646 (34%) are references to publications by women, 1,019 (9%) are to publications by women and men, and 5,679 (53%) are to publications by men. There are 290 (3%) self-citations and 160 (1%) unknown. (See figure 3.)

The reference lists of articles of male authors contain 13,946 records. There are 3,005 (22%) references to publications by women, 1,076 (8%) to publications by women and men, and 9,058 (65%) to publications by men. The self-citations are 539 (4%) and the unknown references are 268 (2%). (See figure 4.)

Figure 2, which illustrates the distribution of references of all articles, shows that references to publications by women

are fewer than references to publications by men. However, the graphs converge with time. This is a natural development according to the tendencies in the area of authorship (figure 1). The increasing share of women in the population of authors means there are more current publications by women to refer to. The time lag between the increase in female authors (figure 1) and the increase in references to publications by women (figure 2) is probably ten years or more if the angles of inclination of the graphs stay constant after the year 2000.

Citation Analysis

This section gives an account of the results, which answer the second question: Does gender seem to affect the share of citations that publications by women and men receive, respectively, in *C&RL*, *JAL*, and *LQ* between 1980 and 2000?

Figure 5 is a combination of the "references to publications of women" graphs from figures 3 and 4. Figure 6 is a combination of the "references to publications of men" graphs from figures 3 and 4.

Figure 5 illustrates the increasing distribution of citations to publications by women during the period, which is





obvious as this figure is based on figures 3 and 4, where this tendency already has been shown. However, in figures 5 and 6, the differences in level between citations to publications by women and publications by men from female and

male authors are exposed more clearly. Although they show increasing and decreasing tendencies respectively, the relative differences between the graphs in figures 5 and 6 stay more or less the same.





Discussion

In the discussion, "female authors" and "male authors" will represent the categories "articles by female authors" and "articles by male authors," a simplification not to complicate the understanding of the text. Also, it should be remembered that, following Ferber's example, this study has investigated whether authors refer more often to authors of the same gender than to authors of the opposite gender. This means that it will not show whether publications by women are cited as often as publications by men but, rather, whether men cite publications by women as often as women do, and vice versa.

Reference Analysis

The shares of references to publications by women are significantly lower than the shares of references to publications by men during the investigated period. (See figure 2.) If it is believed that the rhetorical system provides the prerequisites for the reference process, it would mean that the article authors of this sample assume that their own publications gain more credibility if they refer to publications by men. And if the reward system motivates researchers to use references, the article authors consider themselves to be intellectually indebted to publications by men much more often than to publications by women. And through their respective networks and information channels, the authors more frequently receive information about publications by men than publications by women if the communication system is thought to be the factor that limits the quantity of referable publications.

The share of references to publications by women increases during the period. In view of the three systems, this implies that at the end of the period, publications by women are considered to give higher credibility, authors are more intellectually indebted to publications by women, and more women are involved in networking, than in the beginning.

The findings of this study seem to confirm Ferber's results. Ferber did notice a difference in reference practice between authors in subject areas where the representation of published women were large and areas where the share of published women was small. As the share of female



authors grew larger, more male authors referred to publications by women.²⁷ In this study, the graphs of the references made to publications by women and the references made to publications by men converge in figures 2 and 3. The increasing share of references to publications by women in figure 2, describing the references by all articles, does not depend solely on the increasing share of female authors. Also, the remaining part of male authors refers to an increasing share of publications by women. Do these findings provide enough evidence to assume that



the importance of gender has decreased or even disappeared in LIS publishing?

Figures 3 and 4 show that even if there are tendencies for increasing shares of citations to publications by women and decreasing shares of citations to publications by men, the differences in levels of shares between female and male article authors are remarkable. In figure 3 depicting the referring patterns of female authors, the graphs that show references to publications by women and publications by men are on the same level at the end of the studied period, whereas there is a 30 percent unit difference between the graphs in figure 4, which relates the reference patterns of male authors. So, even if male authors use an increasing share of research by women, they are very far from using as large a share as female authors do. This indicates a gender bias in the choice of references, and the answer to the first question, Does gender seem to affect female and male authors' choice of references in C&RL, JAL, and LQ between 1980 and 2000? is therefore yes as supported by the findings of this study.

Citation Analysis

During the investigated period, publications by women received a much lower share of the accumulated citations in the examined articles than publications by men. In this sample, publications by men could therefore be regarded as having one or more of the following features to a higher extent than publications by women: scientific quality, importance, relevance, utility, influence, impact, or visibility, if the different theoretical interpretations of citations, mentioned above, are considered.

Like the studies by Ferber and by Davenport and Snyder, this part of the study illustrates that gender probably does affect the shares of citations accumulated by female and male authors. Depending on whether the author population is mostly female or mostly male, publications by women and men receive different shares of citations. Paraphrasing Merton's theory of accumulative advantage, this could be called a "gendered Matthew effect." Neither Ferber nor Davenport and Snyder described long-term tendencies. Ferber investigated different subject areas and found that the citation levels were more equal in scientific disciplines where the numbers of female and male authors were approximately the same. This tendency is in a way confirmed by the results of this study, as the share of citations from male authors to publications by women increases as the share of female authors grows.

Consequently, it would have been logical if the graphs in figures 5 and 6 showed a tendency to close in on each other, but this is not the case. The development appears to be the contrary, as the relative difference between the graphs of figures 5 and 6 is constant or even widening. The importance of gender does not seem to disappear even when the share of female authors becomes as large as or larger than the share of male authors, as can be seen when figures 5 and 6 are compared with figure 1 (depicting the shares of articles by female authors, by female and male authors, and by male authors). Instead, the indication of gender bias has become more subtle and complex. The answer to the question, Does gender seem to affect the share of citations that publications by women and men receive respectively in C&RL, JAL, and LQ between 1980 and 2000? is therefore yes considering the results of this particular study.

Conclusion and Need for Further Research

The three LIS core journals seem to be affected by gender bias in the referring process and in the shares of citations authors receive between 1980 and 2000. This conclusion is based on findings that support the assertion that female and male authors appear to have gendered preferences regarding the research they use. The trends shown in the results are not to be considered a deliberate discrimination of female or male authors but, rather, could be a part of the social stratification system of science that, in fact, contradicts central scientific principles such as objectivity. These particular tendencies might be called a "gendered Matthew effect."

Even though the shares of references from both male and female authors to publications by women are increasing according to the results of this study, the relative difference between the shares of citations to publications by women and men from female and male authors is possibly widening. This is somewhat troubling. More research of gender impact on citations is needed, on the one hand, to eliminate the reasonable supposition that the differences depend on variables other than gender and, on the other hand, to explore what the tendency means to LIS research.

Notes

1. See, for example, John N. Olsgaard and Jane Kinch Olsgaard, "Authorship in Five Library Periodicals," College & Research Libraries 41, no. 1 (1980): 49–53; Martha C. Adamson and Gloria J. Zamora, "Publishing in Library Science Journals: A Test of the Olsgaard Profile," College and Research Libraries 42, no. 3 (1981): 235-41 ; Paul Metz, "A Statistical Profile of College & Research Libraries," College and Research Libraries 50, no. 1 (1989): 42-47; James L. Terry, "Authorship in College & Research Libraries Revisited: Gender, Institutional Affiliation, Collaboration," College and Research Libraries 57, no. 4 (1996): 377-83; Wallace Koehler and Olle Persson, "Will It Take Another 50 Years to Reach Equality in Science?" Bibliometric notes 4, no. 6 (Apr. 25, 2000), available online from http://www. umu.se/Inforsk/BibliometricNotes/BN6-2000/BN6-2000.htm [accessed 18 May 2000].

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3. Marianne Ferber, "Citations: Are They an Objective Measure of Scholarly Merit?" Signs 11, no. 2 (1986): 381-89.

4. Loet Leydesdorff, "Theories of Citation?" Scientometrics 43, no. 1 (1998): 9.

5. Terttu Luukkonen, Citations in the Rhetorical, Reward, and Communication Systems of Science (Tampere: University of Tampere, 1990), 6–10,15; Susan E. Cozzens, "What Do Citations Count? The Rhetoric-first Model," Scientometrics 15, no. 5-6 (1989): 441.

6. Leydesdorff, "Theories of Citation?," 6.

7. Luukkonen, Citations in the Rhetorical, Reward, and Communication Systems of Science, 6–10.

8. Cozzens, "What Do Citations Count?," 440.

9. Cited in Luukkonen, Citations in the Rhetorical, Reward, and Communication Systems of Science, 13.

10. Luukkonen, Citations in the Rhetorical, Reward, and Communication Systems of Science, 15.

Cozzens, "What Do Citations Count?," 441.
 Luukkonen, *Citations in the Rhetorical, Reward, and Communication Systems of Science*, 19.

13. Search string (bibliometr* OR authorship OR citation OR co-citation OR co-authorship) AND ((library and information science) OR (library science) OR (information science)), limitation of document type: article. Date of search: 2004-01-28.

14. Ferber, "Citations," 381–89.
15. ——, "Citations and Networking," *Gender and Society* 2, no. 1 (1988): 82–89.

16. Davenport and Snyder, "Who Cites Women?," 404–10.

Ferber, "Citations," 382.
 , "Citations and Networking," 83.
 , "Citations," 382.

20. Ibid., 387.

21. Ibid., 385.

22. Lois Buttlar, "Analyzing the Library Periodical Literature: Content and Authorship," College & Research Libraries 52, no. 1 (1991): 38-53.

23. Ferber, "Citations and Networking," 87.

24. Davenport and Snyder, "Who cites women?," 406.

25. Cited in Martyvonne Nour, "A Quantitative Analysis of the Research Articles Published in Core Library Journals of 1980," Library and Information Science Research 7, no. 3 (1985): 262

26. Martha A. Harsanyi, "Multiple Authors, Multiple Problems—Bibliometrics and the Study of Scholarly Collaboration: A Literature Review," Library and Information Science Research 15, no.

4 (1993): 337

27. Ferber, "Citations and Networking," 87.

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