A New Look at Evidence of Scholarly Citation in Citation Indexes and from Web Sources

Liwen Vaughan*
Faculty of Information and Media Studies, University of Western Ontario, London, Ontario, CANADA, N6A 5B7
E-mail: lvaughan@uwo.ca

Debora Shaw
School of Library and Information Science, Indiana University, 1320 E. 10th Street, Main Library 011, Bloomington, IN 47405-3907
E-mail: shawd@indiana.edu

* To whom correspondence should be addressed.

Abstract

A sample of 1,483 publications, representative of the scholarly production of LIS faculty, was searched in Web of Science (WoS), Google, and Google Scholar. The median number of citations found through WoS was zero for all types of publications except book chapters; the median for Google Scholar ranged from 1 for print/subscription journal articles to 3 for books and book chapters. For Google the median number of citations ranged from 9 for conference papers to 41 for books. A sample of the web citations was examined and classified as representing intellectual or non-intellectual impact. Almost 92% of the citations identified through Google Scholar represented intellectual impact—primarily citations from journal articles. Bibliographic services (non-intellectual impact) were the largest single contributor of citations identified through Google. Open access journal articles attracted more web citations but the citations to print/subscription journal articles more often represented intellectual impact. In spite of problems with Google Scholar, it has the potential to provide useful data for research evaluation, especially in a field where rapid and fine-grained analysis is desirable.

Introduction

We are living through times of rapid change in citation behavior and assessment. Cronin (2005, p. 1505) described the setting: "we will soon have access to a critical mass of web-based digital objects and usage statistics with which to develop multi-dimensional models of scholars' communication behaviors—publishing, posting, blogging, scanning, reading, downloading, glossing, linking, citing, recommending, acknowledging—and with which to track scholarly salience, influence and impact, broadly conceived and broadly felt, over time." As we participate in this revolution, our perceptions and on-the-spot analysis will be useful to see where we are, suggest where we are going, and possibly help future researchers understand what transpired.

In December 2003 we suggested that “web citation analysis is not, or not yet, a replacement for the study of bibliographic citation” (Vaughan & Shaw, 2003, p. 1321). The intervening years have introduced many additional sources for tracking citation practices, most importantly Google Scholar and Scopus. And the web continues to be recognized as an essential part of everyday scholarly life. What effect might these changes make on citation analysis? Are the results from the various citation sources comparable? reliable? We decided to revisit the question of comparability of citation counts from standard sources with those from web searches, again using the subject domain of library and information science (LIS).

Review of the Literature

That thinking about modern citation practices and use is unsettled is evident in the multiplicity and range of writings on the topic. Some, such as Noruzi (2005) use Google Scholar as a way to introduce web users to the basic ideas of citation searching. Roth (2005) lists and describes 17 services that offer reference searching; she terms these “competitors” to *Science Citation Index*. Meho and Yang (in press) counted more than 100 databases that allow citation searching, often as a consequence of providing searchable full text.

Two papers from 2005 reported encouraging comparability between Web of Science (WoS) and Google Scholar citation counts. Belew (2005, p. 3) sampled “six academics ... from a single, particularly interdisciplinary department” and found “relatively small” overlap between WoS and Google Scholar (p. 4); correlation between the citation counts, however, was significant ($p<0.05$). Pauly and Stergiou (2005) searched 99 carefully selected articles from 11 scientific disciplines. They reported such good correlation between Google Scholar and WoS citation counts that they suggested the former “can substitute for ISI” (p. 34).

Other researchers have reported mixed results. Van Impe and Rousseau (in press) found that in their specialized area—local scientific journals in history and archaeology—citations in print or from the web were too infrequent to allow comparison. Kousha and Thelwall (in press 2006, in press 2007) examined citations to open access journals. They found significant correlations between citation counts from WoS, Google Scholar, and what they termed “Google Web/URL citations”—inclusion of a URL in text on the web, regardless of whether it is as a hyperlink.

Bauer and Bakkalbasi (2005) compared WoS, Google Scholar, and Scopus in searches for citations to 1985 and 2000 articles in the *Journal of the American Society for Information Science (and Technology)*. They found that WoS located the most citations to the 1985 articles but Google Scholar performed significantly better for those published in 2000. A follow-on study (Bakkalbasi, Bauer, Glover, & Wang, 2006) reported considerable variation in number of citations from WoS, Scopus, and Google Scholar when compared by year (1993 and 2003) or by discipline (oncology and condensed matter physics).

Jacsó (2005a, 2005b, 2005c) has conducted detailed analyses of citation search results from Google Scholar in comparison with Scopus and Web of Science—which he called “the old reliable” (2005a, p. 1543). Scopus’s coverage of the social sciences he described as “modest” (2005a, p. 1540). Google Scholar, however, he found sorely lacking, not in its scope but in its handling of data; he discussed in detail the "dysfunctional search options" (2005a, p. 1539) and "very poor matching algorithm, which often produces phantom matches" (2005c, p. 6). Neuhaus, Neuhaus, Asher, and Wrede (2006) compared Google Scholar with 47 other databases. They found the best Google Scholar coverage in the scientific and medial literature; coverage of the social sciences was "somewhat hit-or-miss, with roughly 50 percent of the content in these databases indexed by Google Scholar" (Neuhaus et al., p. 138).

Meho and Yang (in press) used WoS, Scopus, and Google Scholar to locate citations to the publications of 25 LIS faculty members. They found less than 60% overlap between WoS and Scopus citations. The number of citations increased as they moved from WoS to Scopus (35.1% more citations), with most of the additional citations coming from conference proceedings. Adding Google Scholar citations to those from WoS-plus-Scopus identified 53% more citations, from more than 30 kinds of sources. The source(s) of citations used affected the relative rankings of faculty members as well. Meho and Yang echo Jacsó (2005c) in their description of the extensive effort needed to extract complete and clean citation data from Google Scholar.

The motivation for web citations has received some attention. Vaughan and Shaw (2003) found that about one third of Google citations to LIS articles were from other articles or conference papers. Kousha and Thelwall (in press 2006) conducted a similar analysis of Google citations to OA journals in library and information science; these citations were often for purposes of formal scholarly communication (equivalent to formal citations, accounting for 43% of the web citations); another 18% reflected informal scholarly communication, such as course syllabi and discussion group postings; and 33% represented navigational uses in web directories or on mirror sites. Vaughan and Shaw's (2005) analysis of Google citations in four scientific fields found intellectual impact in an average of 30% of web citations.

There is mounting evidence that publications available on the web are cited more frequently than those that are less readily available. Lawrence's (2001) analysis for computer science prompted similar studies in disciplines as diverse as XML research (Zhao, 2005) and philosophy and political science (Antelman, 2004). Shadbolt, Brody, Carr, and Harnad (2006) predicted the emergence of powerful retrieval and analysis potential for scholarly research made available through open access. Their work has prompted discussion of how citation analysis (including web citations) could be used to replace the Research Assessment Exercise in the U.K. (Harnad, 2006) (the RAE has been done through peer review and has not made use of citation counts or web-based bibliometric indicators). Simboli (2006) suggested that professional associations might be usefully involved in creating guidelines on how publicly accessible citation count sources, such as Google Scholar, should be used. Davis (2006), however, raised a flag of caution. His analysis demonstrated that republication of an article (for example in print and online) increased its frequency of citation. And Kousha and Thelwall (in press 2007) reported significant disciplinary differences in the comparability of WoS and Google-based citation counts.

Research Methods

Creating the Sample

Our aim was to create a sample that would be representative of research publications by library and information science faculty. We began by identifying all tenured and tenure-track faculty members at the 56 schools with programs accredited by the American Library Association as of fall 2005. We excluded emeritus faculty, lecturers, and adjunct faculty. The resulting list of 720 people included 257 assistant professors, 229 associate professors, and 234 professors.

We randomly selected 30 names from each rank and compiled a bibliography of all journal and conference publications, books, and book chapters for each of these faculty members from: 1) an online CV (if available) plus 2) publications identified through author searches in bibliographic sources. We consulted: *Library Literature & Information Science*, *INSPEC*, *Social Sciences Citation Index*, and *Inside Conferences*, the sources Meho and Spurgin (2005, pp. 1328-1329) identified as "the four periodical databases that provide the most comprehensive coverage of the periodical literature." From these sources we compiled a list of 325 publications by assistant professors (three assistant professors had no publications found), 573 by associate professors (two had no publications found), and 1190 by professors (no professors were without publications in our searches). The large number of publications by professors resulted in a sample too large for the detailed searching and analysis we planned. Therefore, we selected a random sample of 585 items to represent the professors' publications. The resulting bibliography contained 1,483 publications, a reasonably representative sample of LIS faculty scholarly output.

This approach to selecting the publications to examine is, of course, open to criticism. For example, requiring that authors be affiliated with an ALA-accredited master's degree program will exclude some actual and potential contributors to research in the field. And faculty members who have changed names will have only a part of their work included unless they provided a complete bibliography with an online CV. However, the intention was not to produce a high-fidelity representation of LIS faculty research; instead, the effort was to procure a reasonably-sized and arguably representative sample of LIS scholarly output so we could identify and examine citations to these works.

Types of Publications

Each publication was identified as: book, book chapter, conference paper, open access journal article (available free of charge), or print/subscription journal article (subscription required and available in print; most also are available online, but for a fee). There was one report among all publications found. It was omitted from the study as one data point will not form a meaningful category for analysis.

Citation Searches

In December 2005 each of the 1,483 items in our sample was searched in Thomson Scientific's Web of Science and the number of citations was recorded. Then, in the winter and spring of 2006, we searched each item in Google and Google Scholar and recorded the number of hits. For these web searches we entered the title of the publication as a phrase search; titles which were not sufficiently distinctive to retrieve only the citations to the article were supplemented with other bibliographic information such as authors' last names or the title of the journal, whichever made the results more precise. Google Scholar, with its smaller database, typically required shorter queries than those for Google. If Google indicated that some items had been omitted, we selected "repeat the search with the omitted results included." We scanned the search result for false drops and recorded the number of actual hits.

Classification of Types of Web Mentions

We adapted the classification for types of web citations from our 2004 study (Vaughan & Shaw, 2005). The continuing evolution of web content required the extension from eight to ten categories: journal paper, conference paper, book chapter, technical report, master's thesis/doctoral dissertation/student paper, class reading list, bibliographic service, blogger, online paper (not identified as journal paper or conference paper) and other (e.g., author's CV, newsletter, online brochure). This classification allowed us to examine the nature of web citations and to determine what portion represents intellectual impact.

We randomly sampled 105 publications from the 1,483 publications in the study and searched for web citations to these publications. Google and Google Scholar found 4,898 and 928 web citations respectively to these publications. We then attempted to classify manually each Google Scholar citation and a sample of about 20% of the Google citations to the conference papers, journal articles, and book chapters. Not all citations were classified: some were dead links and others were not in English. Still others were the publications themselves rather than the citations to the publications, a problem that was frequently encountered in Google Scholar. There were also many cases of repeated listings of the same citation (i.e., the same webpage listed multiple times); we omitted these repeated listings when we encountered them. In total we were able to classify 759 Google citations and 573 Google Scholar citations.

Findings

Citation Counts

Table 1 summarizes the number of citations to each type of publication. We report both the mean and the median number of citations. Because all the citation frequency distributions are skewed, the median rather than the mean is the appropriate measure; it is therefore used in the analysis reported below. A skewed distribution should be expected; it reflects the Matthew Effect in citations—a small number of star publications attract the lion's share of citations and a large number of publications receive relatively few (Merton, 1968).

Table 1. Citation counts

Type of publication	**Number of publications**	**WoS**		**Google**		**Google Scholar**	
		mean	**median**	**mean**	**median**	**mean**	**median**
Book chapter	32	1.6	0	64.2	28.5	14.4	3
Book	113	5.0	1	66.0	41	6.4	3
Conference paper	432	0.8	0	29.6	9	6.4	2
Open access journal article	49	1.0	0	71.9	52	6.4	3
Print/subscription journal article	857	3.1	0	25.1	10	4.9	1

The data in Table 1 show a clear pattern: for all types of publication, the median number of citations found in Google is greater than the median number of citations found in Google Scholar, which is greater than the median number found in WoS. With the exception of citations to books, the median number of WoS citations is zero. This means that more than 50% of these publications had no citation in WoS database and WoS citation counts would therefore not be an effective measure for comparing “average” publications in this field. Web citation will provide a finer grained measure and be more informative for comparisons within this group.

Open access journal articles received many more web citations, particularly Google citations, than print/subscription journal articles. Although WoS currently indexes only a small portion of all open access journals, these journals’ web presence is much stronger than their traditional counterparts. When comparing these two types of journals it is important to note that all open access journal articles were published since the mid-1990s but some print/subscription journal articles in the study date back to the 1960s. These older articles (published before the advent of the web) had a smaller chance of web visibility. To allow for this difference, we calculated median citation counts for print/subscription journal articles that were published after 1995. The median citation counts for these 445 articles are 15 for Google and 2 for Google Scholar, still lower than that of open access journals (52 and 3 respectively). Thus it is evident that open access journal articles had more web citations than their print/subscription counterparts, although the differences are not as stark when comparing articles published since the introduction of the web. Nevertheless, the differences are still statistically significant for both Google and Google Scholar (Mann-Whitney test, $p<0.05$).

Correlations among Different Types of Citations

Spearman, rather than Pearson, correlation tests were carried out because the frequency distributions of the citations are skewed. The last three columns of Table 2 show the Spearman correlation coefficients. With the exception of the correlation between WoS and Google citations for open access journal articles, all correlations are statistically significant ($p<0.01$). Correlations between Google and Google Scholar citation counts were all high but correlations between WoS and web citation counts varied. For any type of publication, Google Scholar correlated more closely with WoS than did Google. Interestingly, the highest correlation between WoS and web citations is for books; this occurs even though WoS does not index books as extensively as it does journals. The correlations between WoS and web citations for print/subscription journal articles are relatively low (0.31 and 0.43 for Google and Google Scholar respectively) compared with our previous study (Vaughan & Shaw, 2003). The main reasons for the low correlations appear to be the very large number of data points (857) in the correlation tests and the large variability in publication years. Papers published decades ago had very little chance of being cited on the web and papers published in the last three or four years may not had enough time to have their citations recorded in WoS. When we ran the correlation tests including only print/subscription journal articles that were published between 1996 and 2002 (inclusive), the correlation coefficient rose to 0.48 for Google and 0.54 for Google Scholar.

Table 2. Correlation among different types of citations

Type of publication	**Number of publications**	**Correlation between WoS and Google**	**Correlation between WoS and Google Scholar**	**Correlation between Google and Google Scholar**
Book chapter	32	0.60	0.59	0.86
Book	113	0.63	0.75	0.77
Conference paper	432	0.16	0.29	0.80

Open access journal article	49	0.07	0.48	0.63
Print/subscription journal article	857	0.31	0.43	0.75

Types of Web Citations

A total of 1,332 web citations were manually classified as described earlier in the *Research Methods* section. The results of the classification are shown in Table 3 (Google) and Table 4 (Google Scholar). The first number in each cell is the number of citations from that type of source and the second number (in parentheses) is the percentage of all citations to that type of publication from the type of source. The category "full paper" is for papers posted on websites without clearer indication whether it is a journal paper, conference paper or a draft of a paper. The category "report" includes technical reports, organization reports, and white papers. Google Scholar did not include student papers or bloggers either. "Bibliographic services" are lists of articles, for example, ResearchIndex, CiteULike, or institutional archives where only a simple list of papers, not the full paper itself, is present.

The current study found only 5.4% of citations from class reading lists in Google; this was down from 12% in our earlier study (Vaughan & Shaw, 2003). This decline may reflect increased use of WebCT and other password protected websites for course support; these are inaccessible to Google crawlers. We encountered only three class reading lists in Google Scholar; because we believed they were present by accident, we counted them with "other." It appears that Google Scholar does not index course websites.

Different types of web citations highlight the different kinds of impact of the cited work. Being cited in a journal or conference paper, for example, signifies intellectual impact of the work cited. On the other hand, being listed in a bibliographic service does not represent a work's intellectual impact. We consider seven types of web citations to be signs of intellectual impact: journal paper, conference paper, full paper, report, book chapter, thesis/student paper, class reading list. Bibliographic services and "others" represent non-intellectual impact. Mention or discussion in a blog presumably indicates that the work has been read and considered. However, the nature of the intellectual impact is unclear. Because there were few citations from blogs (and none in Google Scholar) we did not include them in subsequent analyses. It should be interesting to see if citations from blogs increase. Figure 1 compares the types of citations in Google and Google Scholar using the percentage figures in the last rows of Tables 3 and 4. The most common type of citation in Google Scholar is clearly journal article, an intellectual type of impact. Google's most common source of citations is bibliographic services, a non-intellectual type of impact. Combining web citation categories to compare intellectual with non-intellectual impacts shows a strong contrast between Google and Google Scholar (see Table 5). Almost 92% of Google Scholar citations suggest intellectual impact but only 40% of Google citations are intellectual type.

Table 3. Sources of citations found in Google

Type of publication	Cited by journal article	Cited by conference paper	Cited by full paper	Cited by report	Cited by book chapter	Cited by thesis/ student paper	Cited by class reading list	Cited by bibliographic service	Cited by blogger	Cited by other source	Total
Book	13 (17.8%)	2 (2.7%)	7 (9.6%)	1 (1.4%)	1 (1.4%)	0 (0%)	4 (5.5%)	30 (41.1%)	2 (2.7%)	13 (17.8%)	73 (100%)
Book chapter	6 (11.3%)	4 (7.5%)	4 (7.5%)	0 (0%)	1 (1.9%)	0 (0%)	0 (0%)	14 (26.4%)	0 (0%)	24 (45.3%)	53 (100%)
Conference paper	37 (24.5%)	4 (2.6%)	14 (9.3%)	0 (0%)	2 (1.3%)	0 (0%)	5 (3.3%)	52 (34.4%)	0 (0%)	37 (24.5%)	151 (100%)
Open access journal article	10 (9.7%)	3 (2.9%)	4 (3.9%)	4 (3.9%)	0 (0%)	0 (0%)	4 (3.9%)	56 (54.4%)	5 (4.9%)	17 (16.5%)	103 (100%)
Print/subscription journal article	73 (19.3%)	11 (2.9%)	32 (8.4%)	16 (4.2%)	3 (0.8%)	7 (1.8%)	28 (7.4%)	137 (36.1%)	4 (1.1%)	68 (17.9%)	379 (100%)
All types of publications	139 (18.3%)	24 (3.2%)	61 (8.0%)	21 (2.8%)	7 (0.9%)	7 (0.9%)	41 (5.4%)	289 (38.1%)	11 (1.4%)	159 (20.9%)	759 (100%)

Table 4. Sources of citations found in Google Scholar

Type of publication	Cited by journal article	Cited by conference paper	Cited by full paper	Cited by report	Cited by book chapter	Cited by thesis	Cited by bibliographic service	Cited by other source	Total
Book	11 (55.0%)	0 (0%)	6 (30.0%)	0 (0%)	0 (0%)	1 (5.0%)	1 (5.0%)	1 (5.0%)	20 (100%)
Book chapter	20 (55.6%)	1 (2.8%)	11 (30.6%)	0 (0%)	1 (2.8%)	0 (0%)	1 (2.8%)	2 (5.6%)	36 (100%)
Conference paper	89 (57.8%)	17 (11.0%)	30 (19.5%)	4 (2.6%)	3 (1.9%)	4 (2.6%)	0 (0%)	7 (4.5%)	154 (100%)
Open access journal paper	18 (37.5%)	9 (18.8%)	9 (18.8%)	4 (8.3%)	1 (2.1%)	4 (8.3%)	0 (0%)	3 (6.3%)	48 (100%)
Print/subscription journal article	163 (51.7%)	31 (9.8%)	56 (17.8%)	12 (3.8%)	9 (2.9%)	12 (3.8%)	13 (4.1%)	19 (6.0%)	315 (100%)
All types of publications	301 (52.5%)	58 (10.1%)	112 (19.5%)	20 (3.5%)	14 (2.4%)	21 (3.7%)	15 (2.6%)	32 (5.6%)	573 (100%)

Figure 1. Comparing types of citations in Google and Google Scholar

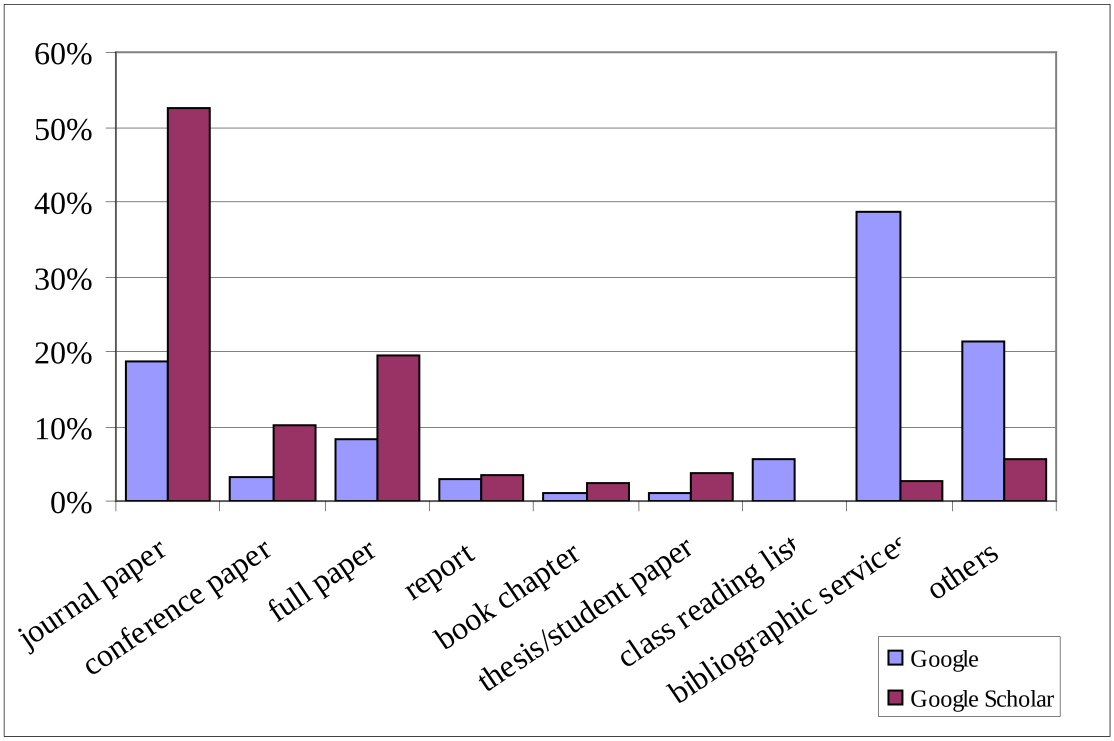

Table 5. Comparing types of impact – Google vs. Google Scholar

Search engine	Intellectual impact	Non-intellectual impact
Google	40.0%	60.0%
Google Scholar	91.8%	8.2%

Table 6 shows the types of impact of Google citations obtained by merging the categories of Table 3. A Chi-square test on this table showed that there is a significant ($p<0.01$) relationship between the types of publications and the types of impact: some types of publication are more likely to have intellectual impact than others. The percentage figures in Table 6 indicate that print/subscription journal articles are more likely to have intellectual type of impact but open access journal articles fall more often into the non-intellectual impact category. The same analysis was applied to Google Scholar data but there was no significant relationship between type of publications and types of impact; the vast majority of Google Scholar citations represent intellectual impact type regardless of the type of publication.

Table 6. Types of impact of Google citations

Type of publication	Intellectual impact	Non-intellectual impact	Total
Book	28 (39%)	43 (61%)	71
Book chapter	15 (28%)	38 (72%)	53
Conference paper	62 (41%)	89 (59%)	151
Open access journal article	25 (26%)	73 (74%)	98
Print/subscription journal article	170 (45%)	205 (55%)	375
All types of publication	300 (40%)	448 (60%)	748

Discussion and Conclusion

As we found in our earlier study (Vaughan & Shaw, 2003), Google citations are much more numerous than WoS citations. With the exception of citations to books, the median number of citations reported in WoS is zero; the web sources, however, were able to locate citations to most of the LIS faculty publications. This means that WoS will provide less detail than web citation studies for comparing citation counts of typical LIS publications or researchers. The median number of Google Scholar citations is 2 to 3, falling between those of WoS and Google.

Open access journal articles attracted many more web citations than their print/subscription counterparts. The median number of Google citations for open access journal articles is 52; that is, a typical open access journal article received 52 mentions in Google. However, a closer examination of the types of web citations showed that only 26% of these Google citations represented intellectual impact. In contrast, 45% of Google citations to print/subscription journal articles represented intellectual impact. There was no significant correlation between WoS and Google citation counts for open access journal articles. However, this correlation is statistically significant for all other types of publications. Clearly, open access journal articles stand out as remarkably different creatures in terms of citations. It is quite possible that the open access movement may cause rapid changes in this mode of scholarly communication and citation patterns to these articles may change as a result. More research in this area is needed to improve our understanding of this phenomenon and chart its evolution.

Although there were strong correlations between Google citation counts and Google Scholar citations counts (around 0.8) for all types of publications, the two kinds of web citation are noticeably different. The most common source of citations in Google Scholar is journal articles, which represent intellectual impact; for Google the most common source is bibliographic services, representing non-intellectual impact. Overall, 92% of Google Scholar citations show intellectual impact, but these account for only 40% of Google citations. Meho and Yang (in press) reported 76% of Google Scholar citations represented intellectual impact: citations from journals (42%) and conference papers (34%). There were, however, fewer sources of citations in Google Scholar; it did not cover bloggers, student papers, or class reading lists. Class reading lists can be a very good indicator of intellectual impact as each list is typically highly selective and created by an expert. Google appears to be finding fewer of these citations in recent years, perhaps because of increased use of WebCT and other course management techniques.

The nature and use of web citations are more complex than was evident just two years earlier.

New sources of web citations include blogger commentary, reports from various sources, and student theses and papers, all of which can be identified through Google searches. Web of Science is highly selective in the sources it indexes. As a consequence, reviewers (including tenure committees) can accept WoS citations as indicators of intellectual impact. Web sources, both Google Scholar and Google, are less selective. They identify more citations and record them sooner but the nature of the impact these citations represent varies considerably.

In general, Google Scholar citations had a stronger correlation with WoS citations than did Google citations. With 92% of Google Scholar citations representing intellectual impact, it has considerable potential to become the primary source for measuring research impact. However, in its current incarnation, Google Scholar has problems. Citing and cited papers are confused; and a single citation act may be represented multiple times when one citing work appears on several web pages. In spite of these problems, Google Scholar is a promising tool for research evaluation. If the current, beta, version of Google Scholar evolves in the right direction, it could be a serious challenger to WoS, which is now the dominant data source of research evaluation (Meho, 2006).

Acknowledgments

The authors appreciate the advice of Blaise Cronin and Lokman Meho on the work reported here. Alexandria Atkinson, Tahir Babar, Emily Ford, and Lin Peng provided invaluable help with data collection.

References

Adkins, D., & Budd, J. (in press). Scholarly productivity of LIS faculty. *Library & Information Science Research*.

Antelman K. (2004). Do open-access articles have a greater research impact? *College & Research Libraries*, *65*(5), 372-382.

Bakkalbasei, N., Bauer, K., Glover, J., & Wang, L. (2006). Three options for citation tracking: Google Scholar, Scopus and Web of Science. *Biomedical Digital Libraries*, *3*. Retrieved August 28, 2006, from http://www.bio-diglib.com/content/pdf/1742-5581-3-7.pdf

Bakkalbasi, N., & Goodman, D. (2004). Do science researchers use books?. Paper presented at the XXIV Annual Charleston Conference: Issues in Book and Serial Acquisition, Charleston, South Carolina. PowerPoint slides retrieved June 23, 2006, from http://dlist.sir.arizona.edu/1106

Bauer K., & Bakkalbasi N. (2005). An examination of citation counts in a new scholarly communication environment. *D-Lib Magazine*, *11*(9). Retrieved February 15, 2006, from http://www.dlib.org/dlib/september05/bauer/09bauer.html

Belew, R. K. (2005). Scientific impact quantity and quality: Analysis of two sources of bibliographic data. Retrieved September 6, 2006, from arXiv:cs.IR/0504036v1

Broadus, R. M. (1971). The literature of the social sciences: A survey of citation studies.

International Social Science Journal, *23*(2), 236-243.

Cronin, B. (2005, November 10). A hundred million acts of whimsy. *Current Science*, *89*(9), 1505-1509. Retrieved June 12, 2006, from http://www.ias.ac.in/currsci/nov102005/1505.pdf

Davis, P. M. (2006). Do Open-Access articles really have a greater research impact? *College & Research Libraries*, *67*(2), 103-104. Retrieved August 25, 2006, from http://hdl.handle.net/1813/2881

Devin, R. B., & Kellogg, M. (1990). The serial/monograph ratio in research libraries: Budgeting in light of citation studies. *College & Research Libraries*, *51*(1), 46-54.

Harnad, S. (2006, June 21). Let 1000 RAE metric flowers bloom: Avoid Matthew effect as self-fulfilling prophecy [posting to the ASIST SIG/Metrics listserv]. Retrieved June 23, 2006, from http://listserv.utk.edu/cgi-bin/wa?A2=ind0606&L=sigmetrics&D=1&O=D&F=&S=&P=8071

Jacsó, P. (2005a). As we may search—comparison of major features of the Web of Science, Scopus, and Google Scholar citation-based and citation-enhanced databases. *Current Science*, *89*(9), 1537-1547. Retrieved January 4, 2006, from http://www.ias.ac.in/currsci/nov102005/1537.pdf

Jacsó, P. (2005b). Comparison and analysis of the citedness scores in Web of Science and Google Scholar. *Digital Libraries: Implementing Strategies and Sharing Experiences, Proceedings of the International Conference on Asian Digital Libraries* (Lecture Notes in Computer Science, 3815), 360-369. Retrieved June 12, 2006, from http://projects.ics.hawaii.edu/~jacso/PDFs/jacso-comparison-analysis-of-citedness.pdf

Jacsó, P. (2005c). *Google Scholar and The Scientist*. Retrieved June 12, 2006, from http://www2.hawaii.edu/~jacso/extra/gs/

Kousha, K., & Thelwall, M. (2006, in press). Motivations for linking to open access LIS library and information science articles: Exploring characteristics of sources of web citation. *Scientometrics*, *86*.

Kousha, K., & Thelwall, M. (2007, in press). Google Scholar citations and Google Web/URL citations: A multi-discipline exploratory analysis. *Journal of the American Society for Information Science and Technology*.

Kurtz, M. J. (2004) *Restrictive access policies cut readership of electronic research journal articles by a factor of two*. Cambridge, MA: Harvard-Smithsonian Center for Astrophysics. Retrieved June 12, 2006, from http://opcit.eprints.org/feb19oa/kurtz.pdf

Lawrence, S. (2001) Online or invisible? *Nature*, *411*(6837), 521.

Meho, L. I. (2006). *The end of monopoly: Citation analysis beyond Web of Science*. Submitted for publication.

Meho, L. I., & Spurgin, K. M. (2005). Ranking the research productivity of library and information science faculty and schools: An evaluation of data sources and research methods. *Journal of the American Society for Information Science and Technology*, *56*(12), 1314-1331.

Meho, L. I., & Yang, K. (in press). New era in citation analysis and bibliometric analyses: Web of Science, Scopus, and Google Scholar. *Journal of the American Society for Information Science and Technology*.

Merton, R. K. (1968). The Matthew Effect in science. *Science*, *159*(3810), 56-63.

Noruzi, A. (2005). Google Scholar: The new generation of citation indexes. *Libri*, *55*(4), 170-180.

Neuhaus, C., Neuhaus, E., Asher, A., & Wrede, C. (2006). The depth and breadth of Google Scholar: An empirical study. *Portal: Libraries and the Academy*, *6*(2), 127-141.

Pauly, D., & Stergiou, K. I. (2005). Equivalence of results from two citation analyses: Thomson ISI's citation index and Google's scholar service. *Ethics in Science and Environmental Politics*, *2005*, 33-35.

Roth, D. L. (2005, November 10). The emergence of competitors to the *Science Citation Index* and the *Web of Science*. *Current Science, 89*(9), 1531-1536.

Schaffer, T. (2004). Psychology citations revisited: Behavioral research in the age of electronic resources. *The Journal of Academic Librarianship*, *30*(5), 354-360.

Shadbolt, N., Brody, T., Carr, L., Harnad, S. (2006). The open research web: A preview of the optimal and the inevitable. In N. Jacobs (Ed.), *Open access: Key strategic, technical and economic aspects*. Retrieved June 23, 2006, from http://eprints.ecs.soton.ac.uk/12453

Simboli, B. (2006, June 6). Professional associations and impact factors [posting on the CHEMINF-L listserv]. Retrieved June 23, 2006, from https://listserv.indiana.edu/cgi-bin/wa-iub.exe?A2=ind0606&L=chminf-l&T=0&P=2608

Van Impe, S., & Rousseau, R. (in press). Web-to-print citations and the humanities. *Wissenschaft und Praxis*.

Vaughan, L., & Shaw, D. (2003). Bibliographic and web citations: What is the difference? *Journal of the American Society for Information Science and Technology*, *54*(14), 1313-1322.

Vaughan, L., & Shaw, D. (2005). Web citation data for impact assessment: A comparison of four science disciplines. *Journal of the American Society for Information Science and Technology,* *56*(10), 1075-1087.

Zhao, D. Z. (2005). Challenges of scholarly publications on the web to the evaluation of science: A comparison of author visibility on the web and in print journals. *Information Processing & Management*, *41*(6), 1403-1418.