Mohammadi, E., & Thelwall, M. (2013). Assessing the Mendeley readership of social science and humanities research. In J. Gorraiz, E. Schiebel, C. Gumpenberger, M. Hörlesberger & H. Moed (Eds.), *Proceedings of ISSI 2013 Vienna: 14th International society of scientometrics and informetrics conference* (pp. 200–214). Vienna: Austrian Institute of Technology GmbH

DOI: 10.6084/m9.figshare.11297348

ASSESSING THE MENDELEY READERSHIP OF SOCIAL SCIENCES AND HUMANITIES RESEARCH

Ehsan Mohammadi[1] and Mike Thelwall[2]

[1] *e.mohammadi@wlv.ac.uk*
Statistical Cybermetrics Research Group, School of Technology, University of Wolverhampton, Wulfruna Street, Wolverhampton WV1 1LY, UK.

[2] *m.thelwall@wlv.ac.uk*
Statistical Cybermetrics Research Group, School of Technology, University of Wolverhampton, Wulfruna Street, Wolverhampton WV1 1LY, UK.

Abstract
There is some evidence that counting the readers of an article in the social reference site, Mendeley, may help to capture the research impact of the article, but the extent to which this is true for different scientific fields is unknown. This study compares Mendeley readership counts with citation counts for different social sciences and humanities disciplines. Mendeley usage data is also used as a novel way to discover patterns of information flow between scientific subjects. The overall correlation between Mendeley readership counts and citations for the social sciences was higher than for the humanities. Low and medium correlations between Mendeley readership and citation counts in all the investigated disciplines suggest that these measures reflect different aspects of research impact. The information flow findings indicate that most users of social sciences and humanities papers are from within the same discipline but some less obvious relationships between scientific disciplines were also discovered. Thus, Mendeley readership can complement citation metrics in many disciplines to help measure broader research impact and to uncover relationships between scholarly disciplines from the reader's perspective.

Keywords: Mendeley, beyond impact, altmetrics

Conference Topic
Scientometrics Indicators (Topic 6), Old and New Data Sources for Scientometric Studies (Topic 2), Webometrics (Topic 2)

Introduction
Research evaluators have often attempted to measure the impact of academic publications. Traditionally, librarians and information professionals have used re-shelving statistics to examine the value of scholarly artefacts (Blecic, 1999) but this is not useful for individual journal articles. The provision of large-scale citation data by the Institute for Scientific Information (ISI), now Thomson Reuters), paved the way for a significant change in the investigation of scholarly commutation and research evaluation. However, citation analysis is restricted to

measuring the impact of publications from an author's perspective but an article could be useful for other contexts such as teaching, commercialisation, and daily working life (Schloegl & Stock, 2004; Haustein & Siebenlist, 2011). In particular, citation metrics are more appropriate for the evaluation of theoretical publications than for applied research. Moreover, there is a worry that a new generation of authors could believe that "citation analysis is a waste of time because authors do not adequately cite those who have influenced their work" (Garfield, 2011).

During the last decade, usage data have been proposed to measure scientific impact to complement citation analysis (Rowlands & Nicholas, 2005; Bollen, Van De Sompel, Smith, & Luce, 2005; Schloegl & Gorraiz, 2011). Usage statistics are able to capture broader research activities (Kurtz & Bollen, 2010) and are obtainable earlier (Brody, Harnad, & Carr, 2006) than citation indicators. As a result, several novel metrics have been suggested based on download data for measuring the impact of scientific publications (Bollen, Van De Sompel, Hagberg, & Chute, 2009). However, most investigations have employed local usage data since global usage statistics are hidden by commercial publishers (Schloegl & Gorraiz, 2010) for privacy and marketing issues. The value of a download also depends on who accessed an article and how it was used (Thelwall, 2012). Moreover, the availability of an article through multiple platforms (Rowlands & Nicholas, 2007) and "data aggregation" are other challenges for accurate usage data (Haustein & Siebenlist, 2011).

The altmetric movement aims to capture new and previously invisible types of impacts of scholarly publications based on crowdsourcing data in social web platforms like blogs, microblogs, social bookmarking tools and online reference managers (Priem, Taraborelli, Groth, & Neylon, 2011). Data collection for altmetrics can often be based on open APIs (Priem, Piwowar, & Hemminger, 2012) which are faster and more accessible than classical usage data and are easy to integrate together (Priem et al., 2011). Amongst web 2.0 platforms, social bookmarking tools, such as CiteULike, Connotea and BibSonomy, may help to overcome the lack of global and "publisher-independent" usage data (Haustein & Siebenlist, 2011). A particularly promising example is Mendeley, a social reference manager that claims to have 2 million users and a database 45 times larger than CiteULike.

Although there has been much discussion about the value of Mendeley as an altmetric source (Priem & Hemminger, 2010; Bar-Ilan et al., 2012; Bar-Ilan, 2012), it has still not been fully evaluated. Previous investigations have found a correlation between Mendeley readership and citation counts for *Nature* and *Science* articles (Li, Thelwall, & Giustini, 2012) and for Genomics and Genetics articles (Li & Thelwall, 2012) but no study so far has examined the relationship between the two measures across different disciplines. The present research addresses this issue by assessing whether the relationship between Mendeley readership and citation counts varies across different social sciences and humanities disciplines. Social sciences and humanities studies are not cumulative and topics are not globally agreed in these disciplines (Becher & Trowler, 2001);

thus citation analysis is less effective for estimating research performance in these areas than in the hard sciences (Nederhof, 2006). As a result, developing appropriate indicators for the research evaluation of the social sciences and humanities has been important for the last three decades (Moed, Linmans, & Nederhof, 2009). Additionally, "usage metrics" are reasonable measures for fields such as social science and humanities with many pure readers (Armbruster, 2008). Moreover, "cross-disciplinary citations" are routinely used to measure the information flow from one discipline to another, but this is not ideal (Rinia, Van Leeuwen, Bruins, Van Vuren, & Van Raan, 2002) due to the inherent limitations of citation analysis. Thus, another objective of this study is to examine whether Mendeley can reflect information flow across different scientific disciplines from the users' perspectives.

Research questions

Although previous studies have found significant moderate correlations between citations and Mendeley readership counts for specific sets of articles, it seems that no previous research has investigated the relationship between Mendeley readership counts and citation measures in a range of specific disciplines. This is important because the citation behaviours of disciplines are known to vary and so Mendeley readership counts may not always correlate with citation counts. The current research partly fills this gap by investigating the correlation between Mendeley readership and citation counts for different social sciences and humanities disciplines. Additionally, measuring knowledge transfer through citation analysis is restricted to author activities while many other scholars, such as students and practitioners, are consumers of research papers. In this study, we also use Mendeley readership data to discover relationships between social sciences and humanities disciplines. The following research questions drive the investigation.

1. Are there significant, substantial and positive correlations between Mendeley readership counts and citation measures in all social sciences and humanities disciplines? If so, are there significant differences between disciplines?
2. Can Mendeley readership reveal patterns of information flow between disciplines?

Related Research

Bookmarking and Mendeley

Social web services connect people (Ding et al., 2009) as well as documents. Scholars can now communicate via web 2.0 products, including social bookmarking tools, Twitter, blogs, and wikis. These tools are potential sources for measuring the impact of scholarly publications at the article and journal levels though many aspects of these social platforms are unknown (Eysenbach, 2011). Altmetrics, a subdivision of scientometrics and webometrics, tries to identify new

metrics based on scholars' activities in online platforms for research evaluation (Priem, Groth, & Taraborelli, 2012). This new approach complements traditional methods and aims to cover broader scientific activities through expanding audiences and using new information sources (Bar-Ilan et al., 2012; Priem, Piwowar, & Hemminger, 2012). In particular, the new generation of personal reference manager tools could provide valuable data for article-level metrics (Neylon & Wu, 2009).

Social bookmarking tools allow users to save and distribute various information resources (Arolas & Ladrón-de-Guevar, 2012). A survey of recent authors found that around 7% of participants used social bookmarking systems (Mark Ware Consulting, 2008). Haustein & Siebenlist (2011) used bookmarking data for 45 physics journals from CiteULike, Connotea and BibSonomy in order to evaluate journals. They defined several indicators based on the bookmarking data. Significant correlations between measures derived from social bookmarking and JIFs (Journal Impact Factors) indicated that social bookmarking data are valuable and could be a useful source for evaluating journals from the reader's perspective. Comparing Mendeley and CiteULike user counts with WoS and Google scholar citation counts for 1613 articles of Nature and Science in 2007, Li, Thelwall and Giustini (2011) found significant correlations between the new measures and citation counts and concluded that Mendeley was more appropriate than CiteULike for research assessment in the studied sample. Bar-Ilan (2012) compared WoS, GS and Scopus citation counts for JASIST between 2001 and 2010 with Mendeley readership counts. Moderate correlations of around 0.5 suggested that "reading and citing are two different scientific activities". Li and Thelwall (2012) examined the relationship between citation measures and two altmetric indicators, Mendeley readership and F1000 article factors (a post-publication peer review score) for a sample of Genomics and Genetics articles published in 2008 that were reviewed by F1000 Faculty Members. They found significant correlations between citation counts and the two altmetric measures. The correlations were stronger for Mendeley readership counts than for FFa scores: evidence for a closer relationship between Mendeley readership and classical citation impact. A comparison between social bookmarking data for PLoS articles with other metrics showed that there was enough data in social media about biomedicine articles for research evaluation purposes (Priem et al., 2012).

Interdisciplinary Knowledge transfer

Science policymakers and funders sometimes promote interdisciplinary research between scholars to overcome sophisticated research problems (Levitt & Thelwall, 2011) and cross-fertilization seems also to be a vital element in modern science (Morillo, Bordons, & Gómez, 2003). Thus, researchers may use publications from outside their disciplines more (Bordons, Morillo, & Gómez, 2005) and it is therefore increasingly important to study the information flow between disciplines. Interdisciplinarity can be conceptualised in two different

ways, *big* and *small* (Rinia, 2007). Small interdisciplinarity deals with interactions between sub-disciplines while big interdisciplinarity refers to relations between different disciplines. It seems that some disciplines are mainly "donors" while others are "receptors" (Pair, 1980).

This review covers studies of different aspects of interdisciplinarity in social sciences and humanities disciplines. Urata (1990) used expert migration and citation flows to identify relationships between social science and humanities disciplines in Japan. The results revealed that sociology and education imported many ideas from other disciplines while psychology, linguistics, philosophy and history exported to other areas. For the social sciences, Gingras and Larivière (2010) found that interdisciplinary decreased from 1965 to 1992, but rose sharply after 1994. Levitt and Thelwall (2011) investigated changes of interdisciplinarity in social sciences disciplines in 1990 and 2000 with similar results: interdisciplinarity diminished between 1980 and 1990 but increased strongly from 1990 to 2000.

Stevens (1990) examined the relationship between planning (Krueckeberg, 1985) and other social sciences disciplines. He found that half of the planning information was from economics whereas geography, environmental studies and economics were the main users of planning publications. An investigation into articles from the four main journals of sociology and political science indicated that the boundaries of these disciplines were not limited (Pierce, 1999). Goldstone and Leydesdorff, (2006) claimed that cognitive science, as an interdisciplinary subject, is like a hub for knowledge exchange between computer science, neuroscience, psychology and education. Cognitive science articles were often used by computer scientists while cognitive science researchers cited psychology publications more. Neeley (1981) applied citation analysis to measure the relationship of management to other social sciences fields, finding that management scholars often cited other disciplines but not vice versa. Another study of management journals revealed that this field was a significant donor for psychology while a large amount of information was imported from economics, psychology, and sociology (Lockett & McWilliams, 2005). Bedeian, (2005) argued that drawing a large amount of information from other disciplines shows a good level of integration with them. Cronin and Pearson (1990) analysed citations to the scholarly artefacts of some senior information scientists and found that few of these publications were used by scholars from outside of the field. Conversely, results of an empirical study in 2005 showed that the pattern of LIS research has changed in terms of interdisciplinarity and LIS articles have been cited by several other disciplines (Tang, 2005). Cronin and Meho (2007) used large-scale data to re-examine the conclusions of Cronin and Pearson (1990), finding that information science transferred ideas to other disciplines more and used publications from computer science, engineering, and business and management more in the last decade. Recently, information science and library science has had the highest increase in interdisciplinarity among the social sciences disciplines (Levitt & Thelwall, 2011).

Data collection

We used two search queries (appendix 1) in the Social Science Citation Index (SSCI) and the Arts and Humanities Citation Index (AHCI) to retrieve all social sciences and humanities publications indexed by Web of Science (WoS) in two separate searches. The results were limited to research articles in English only (reports, editorials, book reviews, etc. removed) from 2008. The year 2008 was selected because the peak time for citations is usually three years after an article is released (Moed, 2005).

In order to classify the results into social sciences and humanities disciplines, we used the ISI subject categories. We used citation counts for each article based on the WoS data at the time of data collection (August 2012).

Table1. Coverage of articles from social sciences and humanities disciplines in Mendeley

Disciplines	*Articles indexed by WoS in 2008*	*Unique articles covered by Mendeley*	*Unique articles with readership statistics*	*Articles without readership statistics*
Psychology	23,811	14,757 (62%)	12,804 (54%)	1,953 (8%)
Interdisciplinary social sciences	6,366	3,763 (59%)	2,416 (38%)	1,347 (21%)
Education and educational research	7,208	3,839 (53%)	2,796 (39%)	1,043 (14%)
Library and information science	2,552	1,617 (63%)	1,343(53%)	274 (10%)
Business and Economics	22,710	12,337 (54%)	8,199 (36%)	4,138 (18%)
Total	62,647	36,313 (58%)	27,558 (44%)	8,755 (14%)
Philosophy	2,833	1,060 (37%)	468 (17%)	592 (21%)
History	2,882	756 (26%)	253 (9%)	503 (17%)
Linguistics	2,245	1,046 (47%)	773 (34%)	273 (12%)
Literature	4,622	643 (14%)	165 (4%)	478 (10%)
Religion	2,058	640 (31%)	255 (12%)	385 (19%)
Total	14,640	4,145 (28%)	1,914 (13%)	2,231 (15%)

We used Webometric Analyst (lexiurl.wlv.ac.uk) to automatically extract Mendeley data for the selected articles via the Mendeley API (Application Programing Interface). As multiple versions of an article sometimes exist in Mendeley, we identified duplicate records based on Mendeley unique IDs, Mendeley URLs, DOIs and probable duplications were checked and removed manually. In the case of duplication, records with the fewest readers were excluded. Out of 41,624 Mendeley records, 1,166 records (3%) were discovered to be duplicates. Some of the articles in the Mendeley catalogue did not have readership statistics and instead of statistical data the phrase “Readership statistics

are being calculated" is displayed. Perhaps Mendeley loaded these articles straight from the publishers' websites or some of the users added own publications to their Mendeley profiles but no one had saved these articles in a personal library. Most of the records removed due to duplication did not have readership statistics. Table 1 shows that 44% of the articles from the chosen social sciences were in the Mendeley catalogue in comparison only 13% of the humanities articles. Library and information science (53%) and linguistics (34%) had the highest coverage in Mendeley among other social sciences and humanities disciplines respectively. Education (39%) and Literature (4%) had the lowest percentage of articles in the Mendeley database. Therefore, 27,558 and 1,914 articles of the social science and humanities disciplines, respectively, which had Mendeley readership statistics were used in this study. Spearman correlation tests were applied to the ISI citations and Mendeley readership counts. Spearman correlation was used rather than Pearson correlation because the frequency distributions of readership and citation counts were skewed.

Findings

Table 2 shows that there is a significant correlation between Mendeley readership and citation counts in all the investigated disciplines. The correlation for social sciences disciplines overall (0.516) is higher than for humanities disciplines (0.428). There were moderate correlations for social sciences disciplines, varying from 0.403 (interdisciplinary social sciences) to 0.573 (business and economics). Amongst humanities disciplines, religion and philosophy have the lowest correlations (0.363 and 0.366) and linguistics has the highest correlation (0.454).

Table 2. Descriptive statistics and correlations between citations and Mendeley readership counts for articles from 2008 with Mendeley readership statistics in different social sciences and humanities disciplines

Disciplines	*WoS citation median*	*Mendeley reader-ship median*	*Correlation (Spearman's rho)*
Psychology	6.00	6.00	.514**
Interdisciplinary social sciences	4.00	4.00	.403**
Education	4.00	6.00	.484**
Library and information science	4.00	8.00	.535**
Business and Economics	5.00	7.00	.573**
All social sciences	5.00	6.00	.516**
Philosophy	1.00	4.00	.366**
History	1.00	2.00	.428**
Linguistics	2.00	4.00	.454**
Literature	0.00	2.00	.403**
Religion	1.00	3.00	.363**
All Humanities	1.00	3.00	.428**

** Significant at the p = 0.01 level

We explored cross-disciplinary readership as an indication of information flow between disciplines based on users' research backgrounds in their Mendeley profiles. Complete statistical data related to readers' background disciplines for each individual article are not accessible through the Mendeley API because only the three most common readers' background disciplines are revealed. The data are provided in percentile format. For each article and each of the three readers' disciplines, we multiplied the percentage of readers from that discipline with the total number of readers of the article and divided by 100 to obtain the estimated number of article readers from that discipline. This process covered 89% and 82% of the readers' background disciplines for social science and humanities articles.

Table 3. Interdisciplinary readership for social sciences disciplines in Mendeley

Read by / Discipline	*Psychology*	*Interdisciplinary social sciences*	*Education*	*LIS**	*Business and Economics*
Psychology	**64.00%**	**15.80%**	**12.40%**	1.80%	**6.50%**
Social Sciences	**6.50%**	**27.80%**	**7.40%**	**20.50%**	**11.60%**
Education	3.80%	5.40%	**54.40%**	4.40%	1.00%
Business& Economics	3.50%	**11.60%**	1.90%	**14.00%**	**55.70%**
Management	0.90%	3.10%	0.50%	3.50%	**11.00%**
Computer and Information Science	3.10%	4.50%	**9.00%**	**45.90%**	4.70%
Medicine	**6.10%**	**7.70%**	4.90%	3.10%	1.00%
Biological Sciences	**6.60%**	4.50%	1.70%	1.40%	1.50%
Philosophy	0.40%	4.50%	0.20%	0.10%	0.10%
Linguistics	1.90%	0.10%	3.00%	0.20%	0.00%
Arts and Literature	0.20%	0.80%	0.40%	0.30%	0.00%
Others	2.90%	14.20%	4.10%	4.70%	6.90%
Total	112898	13436	20817	13000	74080

*LIS=library and information science.

From Table 3 the majority of readers of all investigated social sciences disciplines are from the home disciplines, except for library and information science and interdisciplinary social sciences. However, the percentages vary across different disciplines, from psychology (64%) to interdisciplinary areas of social sciences (28%). This suggests that most Mendeley readers use scientific information mainly from their own disciplines but that this varies substantially between disciplines.

Table 4. Interdisciplinary readership for Humanities disciplines in Mendeley

Read by / Discipline	*Philosophy*	*History**	*Linguistics*	*Literature*	*Religion**
Philosophy	**32.10%**	4.00%	1.20%	0.90%	**6.60%**
Humanities	**7.20%**	**31.70%**	4.70%	**27.80%**	**23.10%**
Linguistics	2.60%	0.70%	**55.00%**	1.20%	2.50%
Arts and Literature	2.60%	3.80%	2.50%	**27.30%**	1.70%
Social Sciences	**12.40%**	**39.60%**	**7.80%**	**20.60%**	**26.90%**
Psychology	**15.60%**	**6.50%**	**8.40%**	1.30%	**21.40%**
Education	3.70%	2.40%	**7.90%**	2.60%	6.40%
Business Administration	1.10%	1.20%	0.10%	1.00%	1.10%
Medicine	2.42%	0.70%	0.50%	1.00%	3.40%
Biological Sciences	5.00%	0.70%	0.90%	0.60%	2.30%
Computer and Information Science	**6.50%**	2.80%	**9.30%**	**10.10%**	1.10%
Others	8.80%	5.90%	1.70%	5.60%	3.50%
Total	1153	911	3760	650	812

*History and religion have been categorized as a humanities sub-discipline in Mendeley.

Also from Table 3, very few psychology articles have an arts and humanities readership while some psychology literature is read by people from biology (7%) and medicine (6%) perhaps reflecting uses of psychology within biomedicine.
The research backgrounds of many readers of articles of library and information science (46%) are computer and information scientists who mainly focus on computer science rather than library science. Moreover, 21% of the library and information science publications were read by individuals from social sciences disciplines.
Table 4 shows that the most readers of philosophy (32%), linguistics (55%) and literature (27%) are from the same discipline but the majority of users of historical (40%) and religious (27%) articles were from the social sciences.

Discussion

This research examined Mendeley usage data for social sciences and humanities publications from 2008. Spearman correlation tests found positive correlations between Mendeley readership counts and citation counts for all the studied disciplines but the values varied across disciplines. The overall correlation for the social sciences (0.516) was higher than for the humanities (0.428). Some social sciences and humanities disciplines are similar to natural and life sciences fields with a high volume of citations while others resemble classical humanities with a lower citation rate (Nederhof, Zwaan, Bruin, & Dekker, 1989). The higher correlations between Mendeley readership and citation counts are in those disciplines that are closer to hard sciences in terms of citation behaviour while the correlations are lower in the disciplines which more resemble traditional humanities.

The median Mendeley readership counts were higher than the median citation counts in all the studied disciplines except psychology. This is consistent with Mendeley readership capturing broader scholarly activities than citations, since different groups from undergraduate students to senior researchers use Mendeley in their academic activities, and corroborates the value of Mendeley readership data.

Cross-disciplinary readership was also used as evidence of knowledge transfer between social sciences, humanities, and other disciplines. Generally, most readers of the studied social science articles were from the home disciplines. Among humanities disciplines, the most readers of historical and religious papers were people with social sciences research backgrounds, however. Part of the results here may be due to the way in which Mendeley classifies people: for example not having a library and information science category but having a computer and information science category instead. The results will also reflect the size of the disciplines involved and the extent to which Mendeley is used within the disciplines. Hence, the results are likely to be skewed towards larger disciplines and biased towards disciplines using Mendeley the most actively (e.g., perhaps library and information science).

A significant amount of psychology information was read by people from biology and medicine, which is not surprising as they have common research borders. Some links were found between interdisciplinary social sciences and biomedicine as previously reported in a citation analysis study (Zhang, Glänzel, & Liang, 2009). Connections were also found between philosophy, computer and information science, and biology. In the case of library and information science, the main importing disciplines were computer and information science, business and economics, management, education and medicine. This agrees with the findings of Cronin and Meho (2007).

Our findings also illustrate that the investigated disciplines are different in terms of the diversity of relationships with other disciplines. For instance, interdisciplinary social science research areas exported ideas to more different disciplines in comparison to others.

One limitation of this research is that readership is limited to the individuals who choose Mendeley for their reference manager while many scholars use EndNote, RefWorks, and ProCite to organize their references. Another limitation is that around 11%-18% of the readers' background disciplines were excluded because they were not accessible via the Mendeley API. Additionally, our studied sample is restricted to journal articles only while books are a fundamental source of research in many humanities and some social sciences disciplines (Huang & Chang, 2008; Nederhof, 2006). However, social sciences and humanities researchers have begun to publish more in ISI ranked journals (Kyvik, 2003; Butler, 2003). Finally, the study excluded all articles that were not found in Mendeley. Whilst it seems likely that these articles will tend to attract few citations and hence the correlations found would not be much affected by adding

these articles to the correlation calculations, this has not been proven in the current paper.

Conclusions

In answer to the first research question, a significant correlation was found between Mendeley readership and citation counts in all social sciences and humanities but the correlations varied from 0.363 (religion) to 0.573 (business and economics). The overall correlation for social sciences is higher than for humanities. In almost all disciplines, the correlation is not strong enough to conclude that Mendeley readership and citation counts measure the same aspect of research impact. As hypothesised by pervious authors, a likely explanation is that Mendeley captures broader scholarly activities from a variety of readers' perspectives in comparison to citation counts. Hence, Mendeley readership data could be a useful supplementary measure to remedy some limitations of citation analysis across the social sciences and humanities. If Mendeley readership data is to be used for important evaluations, however, then steps would need to be taken to ensure that the results cannot be manipulated by those with a vested interest in a particular outcome.

In answer to the second question, our results reveal that patterns of exporting information from social sciences and humanities disciplines to other disciplines can be extracted based on Mendeley readership and agree to some extent with previous citation-based studies. This agreement is some evidence that the results are not random. Nevertheless, other sources of evidence (e.g., questionnaires) would be needed to fully assess the meaning of these results. Mendeley data could thus capture obvious and less obvious relationships between scientific disciplines. The possibility of identifying inter-disciplinary information flows based on Mendeley usage data provides a new way to measure research influences across disciplines. Mendeley and citation sources together may also provide better insights into the relationships between disciplines.

Appendix 1: Search queries for retrieving social science and art and humanities articles from WoS.

(SO=(A* OR B* OR C* OR D* OR E* OR F* OR G* OR H* OR I* OR J* OR K* OR L* OR M* OR N* OR O* OR P* OR Q* OR R* OR S* OR T* OR U* OR V* OR W* OR X* OR Y* OR Z* OR 0* OR 1* OR 2* OR 3* OR 4* OR 5* OR 6* OR 7* OR 8* OR 9*) AND (PY=2008)) AND Language=(English) AND Document Types=(Article) Timespan=All Years. Databases=SSCI.

(SO=(A* OR B* OR C* OR D* OR E* OR F* OR G* OR H* OR I* OR J* OR K* OR L* OR M* OR N* OR O* OR P* OR Q* OR R* OR S* OR T* OR U* OR V* OR W* OR X* OR Y* OR Z* OR 0* OR 1* OR 2* OR 3* OR 4* OR 5* OR 6* OR 7* OR 8* OR 9*) AND AND (PY=2008)) AND Language=(English) AND Document Types=(Article) Timespan=All Years. Databases=A&HCI.

References

Armbruster, C. (2008). Access, Usage and Citation Metrics: What Function for Digital Libraries and Repositories in Research Evaluation? *Social Science Research Network Working Paper Series*, *128*(Pt 6), 1407–17. SSRN. Retrieved December 2, 2012, from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1088453.

Arolas, E. E., & Ladrón-de-Guevar, F. G. (2012). Uses of explicit and implicit tags in social bookmarking. *Journal of the American Society for Information Science and Technology*, 63(2), 313–322. doi:10.1002/asi.21663

Bar-Ilan, J, Haustein, S., Peters, I., Priem, J., Shema, H., & Terliesner, J. (2012). Beyond citations: Scholars' visibility on the social Web. *17th International Conference on Science and Technology Indicators*. Retrieved from http://arxiv.org/ftp/arxiv/papers/1205/1205.5611.pdf

Bar-Ilan, J. (2012). JASIST 2001–2010. *Bulletin of the American Society for Information Science and Technology*, 24–28.

Becher, T., & Trowler, P. (2001). *Academic tribes and territories (2ed)*. Milton Keynes, UK: Open University Press.

Bedeian, A. G. (2005). Crossing Disciplinary Boundaries: A Epilegomenon for Lockett and McWilliams. *Journal of Management Inquiry*, *14*(2), 151–155.

Blecic, D. D. (1999). Measurements of journal use: an analysis of the correlations between three methods. *Bulletin of the Medical Library Association*, 87(1), 20–5.

Bollen, J., Van De Sompel, H., Hagberg, A., & Chute, R. (2009). A principal component analysis of 39 scientific impact measures. (T. Mailund, Ed.) *PLoS ONE*, 4(6), e6022. doi:10.1371/journal.pone.0006022.

Bollen, J., Van De Sompel, H., Smith, J. A., & Luce, R. (2005). Toward alternative metrics of journal impact: A comparison of download and citation data. *Information Processing & Management*, 41(6), 1419–1440. doi:10.1016/j.ipm.2005.03.024

Bordons, M., Morillo, F., & Gómez, and I. (2005). analysis of cross-disciplinary research through bibliometric tools. In Henk F. Moed (Ed.), *Handbook of Quantitative Science and Technology Research* (pp. 437–456). Kluwer Academic Publishers.

Brody, T., Harnad, S., & Carr, L. (2006). Earlier Web Usage Statistics as Predictors of Later Citation Impact. *Journal of the American Society for Information Science and Technology*, 57(8), 1060–1072.

Butler, L. (2003). Explaining Australia's increased share of ISI publications—the effects of a funding formula based on publication counts. *Research Policy*, *32*(1), 143–155.

Cronin, B., & Meho, L. (2007). The shifting balance of intellectual trade in information studies. *Journal of the American Society for Information Science and Technology*, *59*(4), 551–564.

Cronin, B., & Pearson, S. (1990). The export of ideas from information science. *Journal of Information Science*, *16*(6), 381–391.

Bar-Ilan, J. (2012). JASIST 2001–2010. Bulletin of the American Society for Information …, 24–28. Retrieved November 5, 2012, from http://onlinelibrary.wiley.com/doi/10.1002/bult.2012.1720380607/full

Ding, Y., Jacob, E. K., Zhang, Z., Foo, S., Yan, E., George, N. L., & Guo, L. (2009). Perspectives on social tagging. Journal of the American Society for Information Science and Technology, 60(12), 2388–2401.

Eysenbach, G. (2011). Can Tweets Predict Citations? Metrics of Social Impact Based on Twitter and Correlation with Traditional Metrics of Scientific Impact. Journal of Medical Internet Research, 13(4), e123. doi:10.2196/jmir.2012

Garfield, E. (2011). Full Text downloads and citations: Some reflections. Keynote lecture at the Seminar "Scientific Measurement and Mapping." Santa Fe, New Mexico. Retrieved from http://www.garfield.library.upenn.edu/papers/santafe2011.pdf

Gingras, Y., & Larivière, V. (2010). The historical evolution of interdisciplinarity: 1900-2008. *Eleventh International Conference on Science and Technology Indicators*. Leiden.

Goldstone, R. L., & Leydesdorff, L. (2006). The import and export of cognitive science. *Cognitive science*, *30*(6), 983–93.

Haustein, S., & Siebenlist, T. (2011). Applying social bookmarking data to evaluate journal usage. Journal of Informetrics, 5(3), 446–457. doi:10.1016/j.joi.2011.04.002

Huang, M., & Chang, Y. (2008). Characteristics of research output in social sciences and humanities: From a research evaluation perspective. *Journal of the American Society for Information Science and Technology*, *59*(11), 1819–1828.

Krueckeberg, D. A. (1985). The Tuition of American Planning From Dependency toward Self-Reliance. *The Town Planning Review*, *56*(4), 421–441.

Kurtz, M., & Bollen, J. (2010). Usage bibliometrics. *Annual review of information science and Technology*. Retrieved January 4, 2013, from http://onlinelibrary.wiley.com/doi/10.1002/aris.2010.1440440108/full

Kyvik, S. (2003). Changing trends in publishing behaviour among university faculty, 1980-2000. *Scientometrics*, *58*, 35–48.

Levitt, J., & Thelwall, M. (2011). Variations between subjects in the extent to which the social sciences have become more interdisciplinary. *Journal of the American Society for Information Science and Technology*, *62*(6), 1118–1129.

Li, X, Thelwall, M., & Giustini, D. (2012). Validating online reference managers for scholarly impact measurement. *Scientometrics, 91(2),* 461-471.

Li, X, & Thelwall, M. (2012). F1000, Mendeley and Traditional Bibliometric Indicators. *17th International Conference on Science and Technology Indicators* (Vol. 3, pp. 1–11).

Lockett, A., & McWilliams, A. (2005). The Balance of Trade Between Disciplines: Do We Effectively Manage Knowledge? *Journal of Management Inquiry*, *14*(2), 139–150.

Mark Ware Consulting. (2008). Peer review in scholarly journals: Perspective of the scholarly community an international study. Information Services and Use - *APE 2008 Academic Publishing in Europe, Quality and Publishing,* 28(2), 109–112.

Moed, H F. (2005). *Citation analysis in research evaluation* (Vol. 9). Kluwer Academic Pub.

Moed, H F., Linmans, J., & Nederhof, A. (2009). Options for a comprehensive database of research outputs in Social Sciences & Humanities. Retrieved January 4, 2013, from http://83.143.5.70/download/pdf/foerderung/grundlagen_dfg_foerderung/informationen_fachwissenschaften/geisteswissenschaften/annex_2_en.pdf

Morillo, F., Bordons, M., & Gómez, I. (2003). Interdisciplinarity in science: A tentative typology of disciplines and research areas. *Journal of the American Society for Information Science and Technology*, *54*(13), 1237–1249.

Nederhof, A. J., Zwaan, R. A., Bruin, R. E., & Dekker, P. J. (1989). Assessing the usefulness of bibliometric indicators for the humanities and the social and behavioural sciences: A comparative study. *Scientometrics*, 15(5-6), 423–435. doi:10.1007/BF02017063

Nederhof. (2006). Bibliometric monitoring of research performance in the Social Sciences and the Humanities: A Review. *Scientometrics*, *66*(1), 81–100.

Neeley, J. D. (1981). The management and social science literatures: An interdisciplinary cross-citation analysis. *Journal of the American Society for Information Science*, *32*(3), 217–223.

Neylon, C., & Wu, S. (2009). Article-level metrics and the evolution of scientific impact. *PLoS biology*, 7(11), e1000242. doi:10.1371/journal.pbio.1000242

Pair, C. (1980). Switching between academic disciplines in universities in the Netherlands. *Scientometrics*, *2*(3), 177–191. Retrieved October 28, 2012, from http://www.springerlink.com/index/10.1007/BF02016696

Priem, J., & Hemminger, B. M. H. (2010). Scientometrics 2.0: New metrics of scholarly impact on the social Web. *First Monday*, 15(7). Retrieved from http://firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/view/2874

Priem, J., Groth, P., & Taraborelli, D. (2012). The Altmetrics Collection. *PLoS ONE,* 7(11), e48753. doi:10.1371/journal.pone.0048753

Priem, J., Piwowar, H. A., & Hemminger, B. M. (2012). Altmetrics in the wild: Using social media to explore scholarly impact. *Arxiv preprint arXiv*:1203.4745. Retrieved from http://arxiv.org/html/1203.4745v1

Priem, J., Taraborelli, D., Groth, P., & Neylon, C. (2011). alt-metrics: A manifesto (v 1.01 – September 28, 2011: removed dash in alt-metrics). http://altmetrics.org/manifesto.

Rinia, E. . (2007). *Measurement and evaluation of interdisciplinary research and knowledge transfer*. Universiteit Leiden, The Netherlands.

Rinia, Van Leeuwen, T., Bruins, E., Van Vuren, H., & Van Raan, A. (2002). Measuring knowledge transfer between fields of science. *Scientometrics*,

54(3), 347–362. Akadémiai Kiadó, co-published with Springer Science+Business Media B.V., Formerly Kluwer Academic Publishers B.V.
Rowlands, I., & Nicholas, D. (2005). Scholarly communication in the digital environment: The 2005 survey of journal author behaviour and attitudes. *Aslib Proceedings*, 57(6), 481–497. doi:10.1108/00012530510634226
Rowlands, I., & Nicholas, D. (2007). The missing link: journal usage metrics. *Aslib Proceedings*, 59(3), 222–228. doi:10.1108/00012530710752025
Schloegl, C., & Gorraiz, J. (2010). Comparison of citation and usage indicators: the case of oncology journals. *Scientometrics*, 82(3), 567–580. doi:10.1007/s11192-010-0172-1
Schloegl, C., & Gorraiz, J. (2011). Global usage versus global citation metrics: The case of pharmacology journals. *Journal of the American Society for Information Science and Technology*, *62*(1), 161–170.
Schloegl, C., & Stock, W. G. (2004). Impact and relevance of LIS journals: A scientometric analysis of international and German-language LIS journals - Citation analysis versus reader survey. *Journal of the American Society for Information Science and Technology*, 55(13), 1155–1168. doi:10.1002/asi.20070
Stevens, G. (1990). An Alliance Confirmed Planning Literature and the Social Sciences. *Journal of the American Planning Association*, *56*(3), 341–349.
Tang, R. (2005). Evolution of the interdisciplinary characteristics of information and library science. *Proceedings of the American Society for Information Science and Technology*, *41*(1), 54–63.
Thelwall, M. (2012). Journal impact evaluation: a webometric perspective. *Scientometrics*, 92(2), 429-441. doi:10.1007/s11192-012-0669-x
Urata, H. (1990). Information flows among academic disciplines in Japan. *Scientometrics*, *18*(3-4), 309–319.
Zhang, L., Glänzel, W., & Liang, L. (2009). Tracing the role of individual journals in a cross-citation network based on different indicators. *Scientometrics*, 81(3), 821–838. doi:10.1007/s11192-008-2245-y