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Disciplinary Differences in Altmetrics for Social Sciences

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Abstract

Purpose - The purpose of this paper is to contribute to the understanding of altmetrics in different disciplines of Social Science, first, by investigating the current richness and future potential of altmetrics in the selected social science disciplines and then, by evaluating the validity of altmetrics as indicators of research impact in each discipline through correlation analysis.

Design/methodology/approach – This study uses 3 methods to understand the current richness and future potential of 10 altmetric measures in 9 selected disciplines: (1) investigate the distribution and trend of altmetric data, (2) verify the relationship between citation rate and altmetric presence of the discipline using Pearson correlation, and (3) perform word frequency analysis on tweets to understand different altmetric presence in different disciplines. In addition, this study uses Spearman and Sign Test to find the correlation between altmetrics and citation counts for the articles that receive altmetric mention(s) to test the validity of altmetrics as indicators of research impact.

Findings – (1) There is a steady increase in the number of articles that receive altmetric mentions in all disciplines studied. (2) In general, disciplines with higher citation rates have higher altmetric presence. At the same time, altmetrics are also an effective complement to citation in disciplines with low citation rates. (3) There are a moderate correlation with Mendeley and significant but weak correlations with Tweets and CiteULike in 7 disciplines. (4) Altmetrics are most effective as a predictor of citation counts in Psychiatry, Clinical Psychology and Political Science; appear useful in Nursing and Information Science & Library Science; fairly applicable in Health Policy and Services and Management. However, there is low altmetric presence and lack of correlation with citation counts in Business-Finance and Law disciplines.

Originality/value – This paper furthers our understanding of altmetrics in social science disciplines. It reveals the disciplines where altmetrics are most effective, potentially useful and fairly applicable. In addition, it presents evidence that altmetrics are an effective complement to citation in disciplines with low citation rates.

Keywords Altmetrics, Bibliometrics, Scientometrics, Research Impact, Social Media

Article Classification Research paper

Introduction

Measuring research impact is a critical task for universities, research organizations and funding agencies in decision making and policy setting including recruitment, promotion and grant allocation. As a quantitative measure, citation count has traditionally been a strong indicator upon which to draw conclusions about the research impact of an academic article. It is also the machinery behind other research performance measures such as journal impact factor, g-index, and h-index.

However, citation count and those traditional metrics that were originated in print processes have several limitations and are increasing failing to keep pace with the new ways that a researcher can generate impact in today's digital world (NISO; Priem & Hemminger, 2010).

A key limitation of citation count is timeliness since it may take years for an article to get cited (Sud & Thelwall, 2014). It also does not recognize non-scholarly and other online uses of an article in today's digital environment. In addition, citation does not assess other forms of research outputs such as datasets, software tools, etc. that are increasingly being shared online and used for both academic and non-academic purposes (Piwowar, 2013; Priem, 2013). Observations such as these have led to calls for more timely metrics.

Among the attempts to develop new metrics, altmetrics receive considerable attention due to the ease with which data can be collected and the availability of a wide range of open data sources (Thelwall et.al, 2013). The idea of altmetrics is also fuelled by the growing importance of social media in the research workflow. In their recent study, Rowlands *et al*. (2011) affirmed that social media has become an important complementary channel for disseminating and discovering research.

There are several descriptions of altmetrics including the following:

- "The study and use of scholarly impact measures based on activity in online tools and environments" (Priem, 2014).
- "Altmetrics—short for alternative metrics—aims to measure Web-driven scholarly interactions, such as how often research is tweeted, blogged about, or bookmarked" (Howard, 2012).
- "These alternative metrics refer to more "unconventional" measures for evaluation of research, including metrics such as usage data analysis (download and view counts), web citation and link analyses or social web analysis" (Zahedi et al., 2014).

Proponents of altmetrics see it as a much-needed complement or alternative to traditional metrics. The highly cited altmetrics manifesto lays out key advantages of altmetrics including their potential in identifying important publications, their capacity in being able to track the impact of various kinds of research outputs and their relevance in today's Internet age where much knowledge is being disseminated online (Priem *et al*., 2010).

However, altmetrics based on social media are not yet well understood and the use of altmetrics as indicators of research impact is debatable. In order to understand the validity of altmetrics in research evaluation, it is important to examine the nature of impact exposed by altmetrics. To that extent, some research has been done to investigate the relationship between altmetrics and citation count of articles. The assumption is that, if there is a correlation, it shows that altmetric scores are not random but associated with an established research performance indicator. It will then serve as an evidence for altmetrics as early indicators of research impact (Thelwall *et al*., 2013).

Studies have so far indicated a positive correlation in general but the scopes of previous studies do little to shed light on the disciplinary differences within various social science disciplines. Since social media practices such as Twitter usage (Holmberg & Thelwall, 2014) and citation behaviours are

known to vary across disciplines, it is necessary to investigate the relationship between altmetrics and citations in different disciplines. This study contributes to this discussion by investigating the correlation between 10 altmetric measures and citation counts in 9 social science disciplines. In addition, the study also investigates the presence (the extent to which articles receive altmetric mentions), distribution and trend of 10 metrics in the selected disciplines. The goal is to better understand the current richness and the future potential of altmetrics in the disciplines studied.

Specifically, this study seeks to answer the following research questions:

(1) Is there a correlation between altmetric measures and citation counts in social science disciplines?
(2) What is the potential of altmetrics as indicators of research impact in social sciences?

Literature Review

The study of altmetrics is in its infancy but it is a rapidly growing area of research (Weijen, 2014).

The Presence of Altmetrics

One major focus of the studies has been to find out the presence of altmetrics in various contexts including disciplinary differences. According to the Global Research Report by Mendeley (2012), Biological Science & Medicine readers make up the largest part of Mendeley with 31% while the percentage of Humanities and Social Science readers in Mendeley is only 10% or less. In a study that examined 7 major disciplines, Zahedi *et al.* (2014) reported that 47% of articles from Multidisciplinary Journals, which include elite journals such as Nature and Science, have at least one metrics. The percentage is 36% for Medical and Life Sciences and less than 10% for other disciplines. From these studies, we can see that altmetric presence is high in disciplines with high citation rates - Biological Sciences, Life Sciences and Medicines and Multidisciplinary Journals with high citation rates.

Similar patterns can also be found in a study which examined 3 social science and humanities disciplines: Psychology, Linguistics and History. In Psychology, which has the highest citation rate of the three disciplines, 40% of the articles received at least one altmetric mention while it was less than 20% in the other two disciplines (Htoo & Na, 2015). Although altmetric presence is relatively low for Humanities and Social Science disciplines, Zahedi *et al.* (2014) reported that there is a higher density of Mendeley readership per paper than citations per paper in several fields of Social Sciences and Humanities.

Based on previous altmetrics studies, Mendeley and Twitter are the most common metrics (Costas et al., 2015; Zahedi et al., 2014; Thelwall et al., 2013, Haustein et al., 2014; Htoo & Na, 2015). Other metrics, however, are present in less than 10% of articles suggesting that altmetrics may only be useful to identify the occasional or exceptional articles rather than as universal sources of evidence. This pattern was also confirmed by a comprehensive study which analysed articles in altmetric.com (Robinson-Garcia et al., 2014). Of those articles with altmetric mentions, 87% and 65% are Twitter and Mendeley mentions respectively, while other metrics cover less than 20%.

In summary, previous studies indicate that altmetric presence is different from discipline to discipline and the number of articles that attracts altmetric mentions is found to be higher in disciplines with higher citation rate. More comprehensive studies are required to understand disciplinary differences and the relationship between the citation rate and altmetric presence of a discipline. In addition, although previous studies reveal the existence of altmetrics in various disciplines, it is not clear if the amount of altmetric data is growing or shrinking over time at the disciplinary level. In this study, we investigates the presence, distribution and trend of 10 metrics from altmetric.com in 9 selected social science disciplines to better understand the current richness and the future potential of altmetrics in the disciplines studied.

Correlation

Another area of focus in altmetrics research is to investigate the correlation between altmetrics and citation at different settings. When assessing a new metric for their suitability in research evaluation, a quite common technique is to test its correlation with an established source of evidence such as journal impact factor or citation count. This technique was used in several studies which explored possible new non-citation-based metrics before altmetrics (Brody et al., 2006; Duy & Vaughan, 2006; Kousha & Thelwall, 2007, 2008, 2009; Kousha et al., 2010; Vaughan & Hysen, 2002; Vaughan & Shaw, 2003). For altmetrics, finding their correlation with citation was said to be a logical first step before carrying out other kinds of evaluation such as interviews or questionnaires, content analysis and pragmatic evaluations (Sud & Thelwall, 2014).

Some studies have focused on a single metric, such as Twitter (Eysenbach, 2011; Shuai et al., 2012), blogs (Shema et al., 2014), F1000 (Waltman & Costas, 2014), while others on specific genre, such as readership counts based on Mendeley and CiteULike reference managers (Li et al., 2012; Priem et al., 2011). There are also studies that test a variety of metrics on a single source, such as PubMed (Thelwall et al., 2013) and on a selected set of articles (Zahedi et al., 2014). In general, a moderate to low correlation was found when there is enough data. Mendeley was indicated as the most common metric (63%) and had a moderate correlation (r=0.49) with citation (Zahedi et al., 2014).

On the disciplinary level, Mendeley was tested thoroughly across 10 social sciences and humanities and found to have a moderate correlation with citation in almost all investigated disciplines (Mohammadi & Thelwall, 2014). Htoo & Na (2015) also examined 10 other altmetric measures in 3 social sciences disciplines and found 5 metrics to have a significant correlation with citation in Psychology while only 2 metrics are in Linguistic and History. In biomedical and life sciences, out of 11 metrics investigated, 6 were associated with citation (Thelwall et al., 2013a). These studies revealed that there were disciplinary differences and the reason for the lack of correlation seemed to be due to insufficient data. More comprehensive studies are needed to shed light on the disciplinary differences within altmetrics.

When finding correlation, Spearman is more commonly used than Pearson because typically both altmetric and citation data of article are skewed. However, these correlation tests are not ideal for altmetrics and citation because, on average, recent articles are likely to have more mentions in the social web but low in citation counts while older articles are likely to have more citation counts but low in social media mentions thereby causing a bias towards a negative correlation between altmetrics and citation (Sud & Thelwall, 2014). Therefore, a sign test was introduced in more recent

studies to avoid biases caused by time differences (Sud & Thelwall, 2014; Thelwall et al., 2013). In this study, we use Spearman as well as the sign test for correlation analysis.

Research Methods

Selection of Disciplines and Metrics

Since this study focused on the performance of altmetrics for journal articles in an established social science literature, we used Social Science Citation Index (SSCI) when selecting disciplines and associated journals to be studied. SSCI is part of ISI Web of Science (WoS) core collection and covers over 3,000 social science journals across 55 disciplines. It is the collection of some of the oldest, and most prestigious journals in their respective fields (Social Science Citation Index). Over the past decades, WoS has also been a major source of citation data for scientometric research and citation analysis works.

As shown in Table 1, nine disciplines were chosen from the top, middle and bottom groups from SSCI based on 2013 aggregate impact factor values. Of all the disciplines in SSCI, Psychiatry, Clinical Psychology and Health Policy & Services rank 1, 5 & 8 respectively, belonging to the top group. Management, Information Science & Library Science (LIS) and Business-Finance rank 17, 24 & 30 while Nursing, Law and Political Science rank 36, 44 & 48, belonging to middle and bottom groups respectively.

	Aggregate Impact Factor	*No. of articles in SSCI (2008-2013)*	*No. of articles with at least 1 altmetric mention(2008-2013)*
Disciplines with High Aggregate Impact Factor			
Psychiatry	3.064	52626	18448 (35%)
Psychology, Clinical	2.436	35692	11174 (31%)
Health Policy & Services	2.098	25313	8411 (33%)
Disciplines with Median Aggregate Impact Factor			
Management	1.699	38685	6972 (18%)
Information Science & Library Science (LIS)	1.426	19580	4122 (21%)
Business, Finance	1.267	21185	2251 (11%)
Disciplines with Low Aggregate Impact Factor			
Nursing	1.1	33521	9308 (28%)
Law	0.947	23605	2350 (10%)
Political Science	0.899	31918	7525 (24%)

Table 1. Selected Disciplines in SSCI & Related Number of Articles (2008-2013)

For altmetric data, data from altmetric.com were used. It is necessary to acknowledge here a limitation with altmetric.com. Altmetric.com maintains the policy that data curated via altmetric.com are auditable; therefore, an article must have at least one mention in an auditable

source such as Facebook and Twitter where the identity of the person is verifiable. The articles that have only Mendeley or CiteULike mentions, which are the sources where the individuals who save the bookmarks are not identifiable, are not covered by altmetric.com. Apart from that, however, altmetric.com provides the most comprehensive coverage of metrics of today's altmetrics providers, when it comes to journal articles (Peters et al., 2014).

Table 2 shows the description of the metrics and the nature and source of data which can be extracted from altmetric.com through the use of API. Out of all available metrics, 10 most popular ones were selected: Mendeley, Tweets, CiteULike, FB Walls, Blogs, News, Google+, Reddit, F1000 (Research Highlights), and Pinners. The remaining metrics (e.g., Wikipedia, peer review sites, policy documents, Weibo, Q&A, LinkedIn, etc.) were excluded from the study since very little data is available.

Metrics	Description	Source(s)
Mendeley	The number of Mendeley users who have saved the article to their library	Mendeley (http://www.mendeley.com) [A free online reference manager and social-bookmarking site]
CiteULike	The number of CiteULike users who have saved the article to their library	CiteULike (http://www.citeulike.org/) [A free online reference manager and social-bookmarking site.]
Tweets	The number of tweeters that tweet the article	Twitter (http://twitter.com/) [An online social networking service that allows users to send and read short messages called "tweets"]
FB Walls	The number of Facebook users that post the article on their wall (public posts only)	Facebook (http://www.facebook.com/) [An online social networking site]
Blogs	The number of blogs that mention the article	Over 9,000 academic and non-academic blogs
News	The number of news outlets that mention the article	Over 2,000 mainstream media outlets around the world
Google+	The number of Google+ users that mention the article	Google + (http://plus.google.com/) [An online social networking site by Google]
Reddit	The number of Reddit users that mention the article	Reddit (https://www.reddit.com) [An online social media sharing site where members can post pictures, text, direct links, etc. A source for what's new and popular on the web]
F1000 (Research Highlights)	The number of times the article is recommended by Faculty Members registered with the Faculty of 1000	F1000 (http://f1000.com/) [A scholarly article recommendation site]
Pinners	The number of users who pin the article	Pinterest (http://www.pinterest.com) [A social bookmarking tool]

Table 2: The description and source of 10 altmetric data collected from altmetric.com

Data Collection

In each discipline, DOI, PMID and associated altmetric data of articles from all selected journals were first exported from altmetric.com using Altmetric Explorer. Articles of all dates were downloaded but only those published during the period 2008-2013 were used for analysis. Citation count, publication year, volume, issue and ISSN for each article were then downloaded from WoS using Links Article Match Retrieval Service (Links AMR) API by matching either DOI or PMID. Articles that do not have DOI or PMID and thus unidentifiable in WoS were excluded from the study. The last column of Table 1 shows the number of articles in SSCI which have at least one altmetric mention in altmetric.com.

The Presence of Altmetrics

This study uses 3 methods to understand the presence and potential of altmetrics in 9 selected disciplines: (1) investigate the distribution and trend of altmetric data, (2) verify the relationship between citation rate and altmetric presence of the discipline using Pearson correlation, and (3) perform word frequency analysis on tweets to understand different altmetric presence in different disciplines.

For distribution and trend analysis, the percentage of articles having at least one altmetric mention in each discipline was first investigated. Thereafter, we explored the distribution of each metric in each discipline within the articles that have at least one altmetric mention. As for the trend analysis, we calculated the rate at which altmetric presence changes over time in each discipline as follows:

For each year, Rate = No. of articles with Altmetrics / No. of all the articles in SSCI

As the next step, to assess the validity of previous findings regarding the relationship between citation rate and altmetric presence of a discipline, we examined the correlation between Journal Impact Factor (JIF) of journals and the number of articles that attracts altmetric mention in those journals in each discipline using Pearson correlation.

Finally, word frequency analysis was carried out on tweets in order to find out the topics of the articles which attracted altmetric mentions in each discipline. This was done to help us in our understanding of the possible reasons why altmetric presence in some disciplines are higher than others. When selecting the most frequent words in tweets, we excluded words that are not meaningful (e.g., de) and common words such as paper, article, and study that appeared in 5 disciplines or more.

The use of content analysis methods is observed more frequently in recent altmetrics studies (Costas et al., 2014; Shema et al., 2015; Na, 2015) and “deserved to be more common because in addition to giving evidence about why the raw data was created, which can help to validate metrics as research indicators, they can improve wider understanding of the meaning of the metrics though revealing their typical use contexts” (Sud & Thelwall, 2014). Word frequency analysis is a simple content analysis method which was used before by Scanfeld et al. (2010) for analysis of tweets.

Correlation between Altmetrics and Citation of articles: Spearman

Spearman correlation tests were carried out for each metric to find the correlation between citation counts and the altmetric mentions of the article. The significance level of 0.05 and 0.01 were used.

In both Spearman and Sign Test, only articles with non-zero altmetric scores were included. This discarding policy is consistent with the one in a previous study on altmetrics for biomedical and life sciences articles using the same methods, Spearman and Sign Test, and the same data sources, WoS and altmetric.com (Thelwall et al., 2013). As mentioned earlier, articles included in the study are not the complete list of articles from altmetric.com but the ones with DOIs or PMIDs only. When the identifiers or altmetric data are missing, it may be due to problems in the data collection process. Articles with identifiers and non-zero altmetric score, however, have their data effectively collected and thus more reliable to use in the study.

Correlation between Altmetrics and Citation of articles: Sign Test

In general, newer articles can expect to receive higher altmetric scores than older articles while the opposite is true with citation counts causing bias towards negative correlation. In the sign test, each article is compared only against the two articles which are published immediately before and after it within the same journal. For the three articles, the sign test assesses whether a prediction of the difference in citations for the middle article compared to the others would be successful, based upon any difference in altmetric score for the middle article compared to the altmetric scores of the others.

To illustrate how the sign test is carried out to find correlation between tweets and citation, consider the three article A, B and C are in chronological order with 4, 5, 8 tweets and 1, 4, 3 citation counts respectively. The altmetric score of B(5) is compared with the average altmetric score of A and C ((4+8)/2=6). Since 5<6, it results in a prediction that B will have less citation than the average citation of A and C. The sign test gives three possible outcomes:

Success: the altmetric score of middle article is *higher* than the average altmetric score of the two adjacent articles and its citation is *higher* than the average citation of the two adjacent articles OR the altmetric score of middle article is *lower* than the average altmetric score of the two adjacent articles and its citation is *lower* than the average citation of the two adjacent articles.

Failure: the altmetric score of middle article is *higher* than the average altmetric score of the two adjacent articles and its citation is *lower* than the average citation of the two adjacent articles OR the altmetric score of middle article is *lower* than the average altmetric score of the two adjacent articles and its citation is *higher* than the average citation of the two adjacent articles.

Null: all other cases.

In the above example, the citation of B (4) is higher than the average citation of A and C ((1+3)/2=2). So this test will count as a failure. Z test is used to determine if, out of all the test outcomes, the proportion of success cases is significantly different from the default 0.5. Bonferroni correction is used to reduce the chances of obtaining false-positive results.

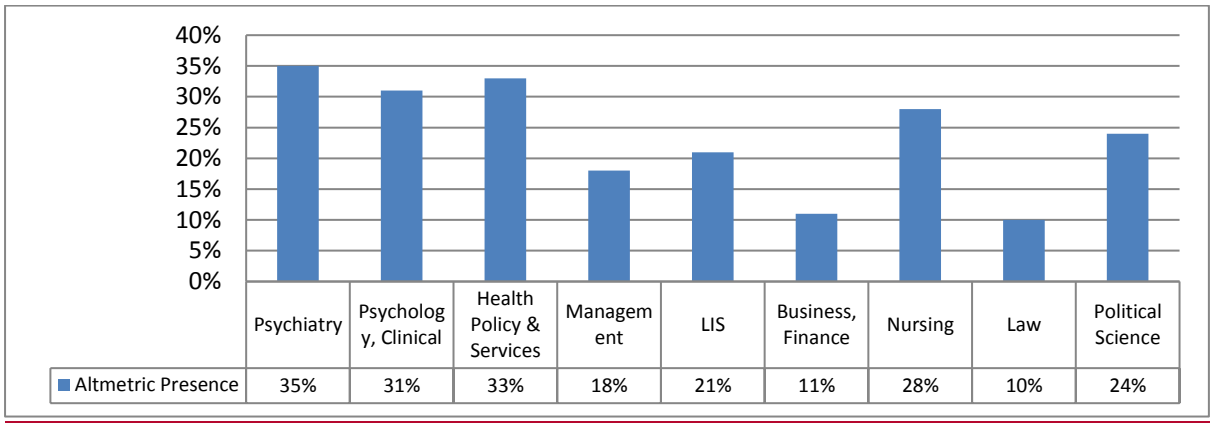
In this study, the sign test was done in the following way:

For each metric, a list was created with all articles that have at least one mention. The list was then ordered by ISSN first to group articles from the same journal. Within the groups, articles were then ordered by year, issue number and volume number to obtain the chronological order. The sign test was carried out for articles within the same groups.

Results and Discussion

The Presence of Altmetrics: Distribution and Trend

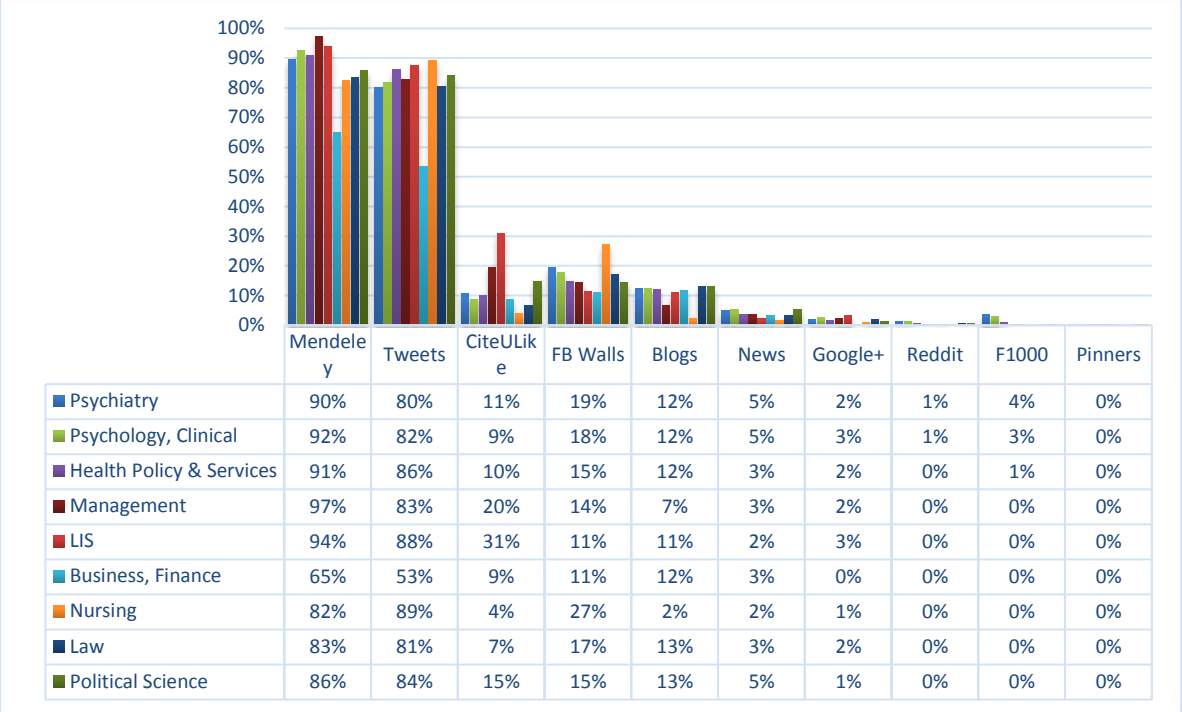
Figure 1 shows the percentage of articles in SSCI having at least one altmetric mention across 9 disciplines for the period 2008-2013. In the table, the top group (Psychiatry, Clinical Psychology and Health Policy & Services) attracted more altmetric mentions than the middle (Management, Information Science & Library Science, and Business-Finance) and bottom (Nursing, Law, and Political Science) groups, following the pattern observed in previous studies, i.e. disciplines with high citation rates have a higher number of articles with altmetric mentions. However, Nursing and Political Science disciplines in the bottom group have a higher number of articles with altmetric mentions than the three disciplines in the middle group, deviating from the pattern. The possible reason for this is explained in the result of word frequency analysis below.



	Psychiatry	Psychology, Clinical	Health Policy & Services	Management	LIS	Business, Finance	Nursing	Law	Political Science
Altmetric Presence	35%	31%	33%	18%	21%	11%	28%	10%	24%

Figure 1: Altmetric Presence in 9 Selected Disciplines (2008-2013)

In Figure 2, we further explored the distribution of altmetric data within the articles that have at least one altmetric mention. Mendeley is the most common metric followed by Tweets in all the 9 disciplines. CiteULike, FB Walls, and Blogs then follows with much lower presence. News, Google+, Reddit, and F1000 take up less than 5%. Pinners presence is the lowest and it is practically non-existent. Our study adds to the previous findings that the altmetric sources that provide the most metrics are Mendeley and Twitter (Robinson-García et al., 2014; Thelwall et al., 2013; Zahedi et al., 2014) by confirming that it is also true at the disciplinary specific level, at least for the 9 social science disciplines studied in this paper.



	Mendeley	Tweets	CiteULike	FB Walls	Blogs	News	Google+	Reddit	F1000	Pinners
Psychiatry	90%	80%	11%	19%	12%	5%	2%	1%	4%	0%
Psychology, Clinical	92%	82%	9%	18%	12%	5%	3%	1%	3%	0%
Health Policy & Services	91%	86%	10%	15%	12%	3%	2%	0%	1%	0%
Management	97%	83%	20%	14%	7%	3%	2%	0%	0%	0%
LIS	94%	88%	31%	11%	11%	2%	3%	0%	0%	0%
Business, Finance	65%	53%	9%	11%	12%	3%	0%	0%	0%	0%
Nursing	82%	89%	4%	27%	2%	2%	1%	0%	0%	0%
Law	83%	81%	7%	17%	13%	3%	2%	0%	0%	0%
Political Science	86%	84%	15%	15%	13%	5%	1%	0%	0%	0%

Figure 2: Distribution of 10 Metrics in 9 Selected Disciplines

Although the presence of altmetrics for the period 2008-2013 is not substantial enough as indicated in both Figure 1 and 2, we can still expect a good potential of altmetrics for future usefulness if altmetric data grow over time. Figure 3 shows the rate at which altmetric presence changes overtime in each discipline. There is a steady increase over the years in all disciplines. This increase may well be due to the changes in the way altmetric.com has collected data. But it could also be reflecting the phenomena reported by Rowlands et al. (2011) about the increased use of social media for disseminating and discovering research.

Quite significant increase can be observed for Psychiatry, Clinical Psychology, Health Policy & Services, Nursing and Political Science. For example, 18% at the beginning of 6 years period in Psychiatry has jumped to 65% at the end of 6 year period. However, there is not much increase in Law and Business-Finance indicating that the potential usefulness of altmetric is low in these disciplines.

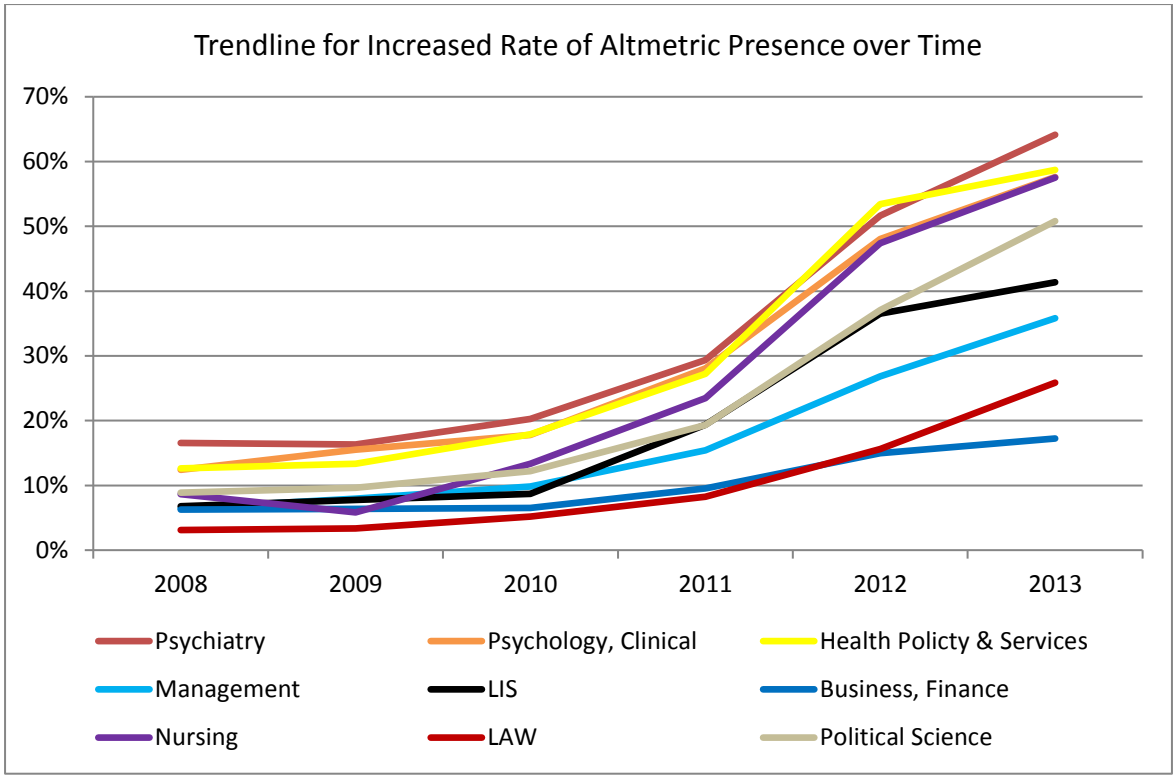


Figure 3: Increased Rate of Altmetric Presence over Time
[Rate = No. of articles with Altmetrics/No. of articles in SSCI]

The Presence of Altmetrics: Relationship between Citation Rate and Altmetric Presence of the Discipline

As for the relationship between the citation rate of a discipline and the presence of altmetrics in that discipline, the result of Pearson correlation indicates that there is a significant relationship between journal citation rates and altmetric presence in all the disciplines but Law. As shown in Table 3, it was found that journal impact factor is highly correlated with the number of articles that attracts altmetric mention in the Business-Finance discipline, moderately correlated in 6 other disciplines (Psychiatry, Clinical Psychology, Health Policy & Services, Management, Information Science & Library Science, and Political Science) and low but significantly correlated in Nursing. The higher the citation rate of the journal, the higher the number of articles that attract altmetric mentions in that journal. This in turn means that, in general, disciplines with higher citation rates have higher altmetric presence. For the special cases such as Nursing and Political Science, the possible causes are revealed in the result of word frequency analysis.

PSYCHIATRY	PSYCHOLOGY, CLINICAL	HEALTH POLICY & SERVICES	MANAGE-MENT	INFORMATION SCIENCE & LIBRARY SCIENCE	BUSINESS, FINANCE	NURSING	LAW	POLITICAL SCIENCE
0.47** N=118	0.40** 99	0.56** 67	0.38** 156	0.49** 60	0.74** 70	0.29** 102	0.23 66	0.49** 132

**Significant at p=0.01

Table 3: Pearson Correlation: Number of Articles with Altmetrics vs Journal Impact factor

The Presence of Altmetrics: Word Frequency Analysis

Table 4 shows the selected 20 most frequent words in Tweets in each discipline, in order of frequency. In general, the words seem to be the typical terms of the discipline but there are some notable findings.

In Political Science, it was found that popular topics are terrorism, war, conflict, governance, women and online which reflect current affairs of the world. Today, there is an unprecedented rise in global terrorism (80% increase according to 2015 Global Terrorism Index) and it also happens to be the time when we see the rise of women in politics. In this study, we can see that these upsurges are reflected in altmetric data making the Political Science more popular on altmetrics than other similar disciplines with low citation rates. This finding is also the evidence that altmetrics are an effective complement to citation in disciplines with low citation rates since they reveal articles on certain topics and trends that are popular on social media and readership metrics but do not get cited much.

In Nursing, out of 20 terms, 4 are variations of the word 'nurse' (nursing, nurses, nurse, and jadvnursing), 8 overlap with the terms in Health Policy & Services (care, patients, practice, patient, life, quality, evidence, and clinical matching hospital) and 4 do not describe meaningful topics (popular, abstract, available, and systematic). This means that the majority of Nursing articles that attract altmetric attention are similar in nature or have the same topics as the articles in Health Policy & Services. This explains why Nursing articles attract similar altmetric mentions to Health Policy & Services articles although the citation rate of Nursing is much lower than that of Health Policy & Services articles.

	PSYCHIATRY	PSYCHOLOGY, CLINICAL	HEALTH POLICY & SERVICES	MANAGEMENT	INFORMATION SCIENCE & LIBRARY SCIENCE	BUSINESS, FINANCE	NURSING	LAW	POLITICAL SCIENCE
No. of Tweets	55965	38408	32592	7221	17544	1781	26076	5502	27469
20 Most Frequent Words	*Disorder (4091)** *Depression (3961)* *Mental (3572)* *Psychiatry (3196)* *Risk (2879)* *Schizophrenia (2846)* *Treatment (2648)* *Anxiety (2460)* *Patients (2313)* *Suicide (2161)* *Symptoms (1788)* *People (1754)* *Bipolar (1749)* *Psychosis (1692)* *Therapy (1666)* *Alcohol (1608)* *adhd (Attention-deficit/hyperactivity disorder) (1601)* *self (1531)* *cognitive (1520)* *children (1438)*	*Sexual (2197)* *Therapy (2139)* *Disorder (1947)* *Anxiety (1894)* *Treatment (1841)* *Risk (1789)* *Disorders (1765)* *Cognitive (1687)* *Depression (1680)* *Sex (1674)* *Eating (1620)* *Women (1580)* *Men (1411)* *Self (1348)* *cbt (cognitive-behavioural treatment) (1183)* *Analysis (1146)* *Behaviour (1044)* *Mental (1036)* *Effects (981)* *Symptoms (978)*	*Care (4617)* *hiv (2582)* *Quality (1714)* *Patient (1622)* *Patients (1622)* *Policy (1323)* *Evidence (1158)* *Safety (1152)* *Healthcare (1117)* *jhppl (Journal of Health Politics, Policy and Law) (1060)* *implementation (963)* *affairs (948)* *risk (915)* *medical (880)* *hospital (869)* *practice (850)* *life (815)* *impact (797)* *access (777)* *mental (769)*	*Innovation (658)* *Management (610)* *Leadership (606)* *Work (421)* *Cimjournal (334)* *Performance (333)* *Business (333)* *Organizational (276)* *Knowledge (250)* *Role (223)* *Change (218)* *Read (211)* *Impact (204)* *Online (198)* *Science (188)* *Why (178)* *Published (168)* *Interesting (163)* *Design (146)* *Analysis (144)*	*Information (1764)* *jasist (Journal of the American Society for Information Science and Technology) (1227)* *impact (819)* *access (836)* *data (804)* *media (759)* *library (787)* *online (757)* *analysis (728)* *academic (666)* *using (592)* *jamia (J Am Med Inform Assoc) (573)* *internet (564)* *web (563)* *science (524)* *electronic (490)* *digital (459)* *knowledge (486)* *patient (455)* *medical (451)*	*Financial (223)* *Finance (176)* *Evidence (152)* *Market (143)* *Stock (128)* *Risk (103)* *Firms (79)* *Capital (76)* *Firm (72)* *Crisis (70)* *Markets (66)* *Corporate (64)* *Investment (64)* *Management (64)* *Accounting (61)* *Economics (59)* *Equity (59)* *Read (58)* *Investors (57)* *Performance (57)*	*Nursing (4907)* *Care (3279)* *Popular (2590)* *Nurses (2544)* *Nurse (1687)* *Patients (1595)* *Abstract (1408)* *Women (1229)* *jadvnursing (AJN, American Journal of Nursing) (1210)* *cancer (1139)* *practice (1135)* *patient (1100)* *available (1058)* *clinical (859)* *life (744)* *experiences (737)* *quality (731)* *education (724)* *evidence (718)* *systematic (661)*	*Law (871)* *Legal (244)* *Read (212)* *International (196)* *Justice (185)* *Criminal (174)* *Analysis (162)* *Sex (162)* *Why (159)* *Sexual (148)* *Mental (140)* *Offenders (136)* *People (124)* *Women (124)* *Rights (121)* *Found (117)* *ptsd (post-traumatic stress disorder) (117)* *crime (116)* *icc (International Criminal Court) (115)* *psychopaths (112)*	*Political (3147)* *Politics (2445)* *Read (1627)* *Policy (1427)* *Why (902)* *Access (819)* *Party(769)* *issue (763)* *global (737)* *democracy (669)* *conflict (665)* *international (613)* *terrorism (599)* *war (597)* *governance (596)* *media (587)* *science (587)* *women (583)* *online (572)* *state (559)*

**frequency of the term*

Table 4: Twenty Most Frequent Words in Tweets

Correlation between Altmetrics and Citation of Articles: Spearman

Spearman test results indicated a moderate correlation with Mendeley in 7 disciplines: Psychiatry, Clinical Psychology, Health Policy & Services, Management, Information Science & Library Science, Nursing, and Political Science (see Table 5). There are also significant but weak correlations with Tweets and CiteULike in those 7 disciplines. The results also showed that Facebook and Blogs have a significant but low correlation with citation count in 4 disciplines: Psychiatry, Clinical Psychology, Nursing, and Political Science disciplines and Psychiatry, Clinical Psychology, Information Science & Library Science, and Political Science respectively.

The remaining metrics (News, Google+, Reddit, F1000, and Pinners), however, were found to have no correlation in all the disciplines. In Business-Finance and Law, there is no correlation with all the metrics except Mendeley in Business-Finance. The low altmetric presence of the articles in Business-Finance and Law disciplines produced the small dataset for correlation tests affecting the test results.

Based on the test results, Mendeley, Tweets, and CiteULike turn out to be most useful metrics, and Facebook and Blogs seem promising metrics. Altmetrics seem most effective for Psychiatry, Clinical Psychology, Political Science disciplines since they have significant and moderate to low correlations with the 5 popular altmetrics: Mendeley, Tweets, CiteULike, Facebook, and Blogs. Altmetrics also appears useful in Nursing and Information Science & Library Science disciplines since they have low but significant correlations with 4 metrics: Mendeley, Tweets, CiteULike, and Facebook or Blogs. Altmetrics can also be fairly applicable in Health Policy & Services and Management disciplines since they have low but significant correlations with 3 metrics: Mendeley, Tweets, and CiteULike. However, the low presence and lack of correlation with citation count could challenge the validity of altmetrics as useful indicators of research impact in Business-Finance and Law disciplines.

From a broader perspective, all disciplines in the top group (Psychiatry, Clinical Psychology, and Health Policy & Services), and two disciplines in each middle group (Management and Information Science & Library Science) and bottom group (Nursing and Political Science) are good candidates for applying Altmetrics. However, Business-Finance from the middle group and Law from the bottom group turn out to be not good candidates for Altmetrics. Therefore, the disciplines having high aggregate impact factor values seem good candidates for applying altmetrics, but for the disciplines having middle and low aggregate impact factor values, popularity of topics needs to be considered also for applying altmetrics.

METRICS	PSYCHIATRY	PSYCHOLOGY, CLINICAL	HEALTH POLICY & SERVICES	MANAGEMENT	INFORMATION SCIENCE & LIBRARY SCIENCE	BUSINESS, FINANCE	NURSING	LAW	POLITICAL SCIENCE
Mendeley	0.61** N=16531	0.60** 10334	0.52** 7657	0.69** 6783	0.58** 3867	-0.07* 1464	0.48** 7667	0.04 1961	0.64** 6461
Twitter	0.10** N=14767	0.05** 9158	0.08** 7239	0.11** 5772	0.08** 3607	0.00 1201	0.13** 8296	-0.04 1894	0.05** 6333
CiteULike	0.21** N=1960	0.23** 988	0.28** 836	0.34** 1368	0.37** 1272	0.10 192	0.22** 375	0.02 159	0.28** 1121
Facebook	0.15** N=3574	0.08** 1991	0.05 1250	0.08 1008	0.09 469	-0.09 251	0.13** 2532	-0.01 404	0.10** 1096
Blogs	0.13** N=2274	0.13** 1393	0.06 1024	0.12 467	0.20** 454	-0.06 267	0.08 205	-0.08 326	0.15** 975
News	-0.03 N=930	-0.04 587	-0.09 291	-0.07 241	0.09 88	0.14 72	-0.08 144	0.07 74	0.09 387
Google+	0.02 N=335	-0.07 283	0.11 133	0.16 164	0.20 139	-	0.14 94	0.14 42	0.06 87
Reddit	0.05 N=206	-0.04 130	0.32 41	0.40 19	0.25 16	-0.48 9	0.09 21	0.54 10	0.23 36
F1000	-	-	-	-	-	-	-	-	-
Pinners	-	-	-	-	-	-	-	-	-

**Significant at p=0.01 *Significant at p=0.05

Table 5: Spearman Correlation: Altmetrics vs. Citation Count

Correlation between Altmetrics and Citation of Articles: Sign Test

As shown in Table 6, Sign Test revealed significant correlations with Mendeley, Tweets, CiteULike, Facebook Walls, Blogs, and News in Psychiatry discipline. Unlike Spearman correlation results for Psychiatry where News has a negative correlation (-0.03234) with citation count (Table 5), Sign Test indicates a positive and significant correlation between News and citation count. Similar case can be found in Clinical Psychology (Table 7).

Apart from detecting erroneous negative correlations, it seems that Sign Test is not effective in detecting positive significant correlations. Although Sign Test indicates that, in general, success rates are higher than failure rates, more data is essential to reveal significant correlations. On the other hand, Spearman seems more reliable in detecting correlation with altmetrics since it could detect expected correlations between popular metrics (such as CiteULike or Tweets) and citation count. Therefore, in our evaluation, we report mainly the results of Spearman correlation tests.

Metric	Success	Failure	Z	Null	Total Tests	Journals	Articles
Mendeley**	8376 (64%)	4733 (36%)	31.8	3190	16299	118	16531
Tweet**	5484 (56%)	4316 (44%)	11.8	4733	14533	118	14767
CiteULike**	474 (57%)	355 (43%)	4.1	939	1768	101	1960
FB_Walls**	717 (55 %)	594 (45%)	3.4	2048	3359	111	3574
Blogs**	391 (60%)	262 (40%)	5.0	1418	2071	107	2274
News*	203 (59%)	143 (41%)	3.2	423	769	88	930
Google_Plus	31 (54%)	26 (46%)	0.7	155	212	75	335
Reddit	14 (64%)	8 (36%)	1.3	106	128	49	206
F_1000	0	0	0	563	563	56	655
Pinners	0	0	0	2	2	11	15

**Significant at p=0.01, Bonferroni corrected for n=10.

*Significant at p=0.05, Bonferroni corrected for n=10.

Table 6: Sign Test - Correlation between metric values and citations for all articles with non-zero scores on each altmetric (Psychiatry)

Metric	Success	Failure	Z	Null	Total Tests	Journals	Articles
Mendeley**	5646 (64%)	3156(36%)	26.5	1339	10141	98	10334
Tweet**	3467 (56%)	2673(44%)	10.1	2824	8964	98	9158
CiteULike	222 (53%)	193(47%)	1.4	415	830	81	988
FB_Walls	415 (55%)	340(45%)	2.7	1053	1808	95	1991
Blogs**	316 (63%)	185(40%)	5.9	727	1228	87	1393
News*	146 (59%)	102(41%)	2.8	200	448	76	587
Google_Plus	37 (51%)	35(49%)	0.2	109	181	62	283
Reddit	19 (58%)	14(42%)	0.9	30	63	46	130
F_1000	0	0	0	284	284	39	348
Pinners	0	0	0	1	1	9	11

**Significant at p=0.01, Bonferroni corrected for n=10.

*Significant at p=0.05, Bonferroni corrected for n=10.

Table 7: Sign Test - Correlation between metric values and citations for all articles with non-zero scores on each altmetric (Clinical Psychology)

Conclusion

This study investigated the presence, distribution and trend of 10 altmetric measures in 9 selected social science disciplines. In addition, the study evaluated the validity of altmetrics as indicators of research impact in each discipline through correlation analysis. There are several key findings from the study. Firstly, overall altmetric presence in 9 disciplines for the period 2008-2013 is low: from 10 to 35 percent. However, there is steady and significant increase over the years especially in Psychiatry, Clinical Psychology, Health Policy & Services, Nursing and Political Science. Secondly, there is a significant relationship between journal citation rate and altmetric presence. This in turn means that, in general, disciplines with higher citation rates have higher altmetric presence. At the same time, altmetrics are also an effective complement to citation in disciplines with low citation rates since they can reveal articles on certain topics and trends that are popular on social media and readership metrics but do not have much citation. Thirdly, this study adds to the previous findings that the altmetrics sources that provide the most metrics are Mendeley and Twitter (Robinson-García et al., 2014; Thelwall et al., 2013; Zahedi et al., 2014) by confirming that it is also true at the disciplinary specific level, at least for the 9 social science disciplines studied in this paper.

Finally, this study revealed a moderate correlation between citation and Mendeley and, significant but weak correlations with Tweets and CiteULike in 7 disciplines. The study also pointed out Psychiatry, Clinical Psychology and Political Science disciplines to be the ones where altmetrics seem most effective as a predictor of citation counts. Altmetrics also appear useful in Nursing and Information Science & Library Science disciplines and fairly applicable in Health Policy & Services and Management disciplines. However, the low presence and lack of correlation with an established indicator of research impact could challenge the validity of altmetrics as useful indicators of research impact in Business-Finance and Law disciplines.

On the whole, this study sheds light on, in a more detailed manner than previous studies, different performance of altmetrics in different disciplines within social sciences. To further understand the behaviour of altmetrics in this aspect, research in more disciplines using both qualitative and quantitative methods are necessary.

In the early days of citation metric, the importance of citations in science evaluation and their ambiguity have made the motivations behind citations a popular research subject (Shema et al, 2015). The rise of altmetrics has also brought into question the motivation behind online citations or mentions to scholarly materials. This is an area ripe for research. After the initial exploration done in this study, the next possible question to ask is: what are the disciplinary differences in altmetrics in terms of contributors, their motivation and sentiments? Future research can employ sentiment analysis, profiling of contributors, content analysis, even interviews and surveys, in answering this question.

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