Altmetrics for large, multidisciplinary research groups: Comparison of current tools

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Abstract

Most altmetric studies compare how often a publication has been cited or mentioned on the Web. Yet, a closer look at altmetric analyses reveals that the altmetric tools employed and the social media platforms considered may have a significant effect on the available information and ensuing interpretation. Therefore, it is indicated to investigate and compare the various tools currently available for altmetric analyses and the social media platforms they draw upon. This paper will present results from a comparative altmetric analysis conducted employing four well-established altmetric services based on a broad, multidisciplinary sample of scientific publications. Our study reveals that for several data sources the coverage of findable publications on social media platforms and metric counts (impact) can vary across altmetric data providers.

Keywords:

Altmetrics; data providers; social media platforms; impact; scientific publications

1 Introduction

The Internet – specifically the social Web – has not only created new possibilities for organizing scientific work and communicating findings, it has also created new instruments to help audiences observe and evaluate these findings. Altmetrics (Priem et al., 2011) aim at measuring the impact of publications and other research products, e.g., articles, books, data sets, videos, presentations, conference proceedings, slides, etc. on the Web in a way that goes beyond traditional indicators of bibliometrics, e.g., the Journal Impact Factor or the h-index. Altmetric data comprises usage data, e.g., downloads, and indicators of the contribution´s reception among the target audience, e.g., tweets, bookmarks, or shares. Hence, the indicators used for altmetric analyses are primarily influenced by two aspects: 1) the social media platforms on which scientific publications can be found and discussed, e.g., Facebook and ResearchGate, and 2) users who engage with scientific publications by making use of the affordances provided by the social media platforms, e.g., save publications on Mendeley or retweet them on Twitter.

In altmetric studies, most attention is directed at the latter aspect, e.g., when comparing how often a publication has been cited or tweeted (amongst others: Haustein et al., 2014). Yet, the tools employed and the platforms considered in altmetric analyses may have a significant effect on the resulting information and interpretation. In order to conduct a comprehensive analysis of various tools currently available for altmetric analyses, as well as the social media platforms they draw upon, this study will present results from a comparative altmetric analysis conducted employing four well-established altmetric services based on a broad, multidisciplinary sample of scientific publications.

The paper is organized as follows: Section 2 provides an overview on the related literature. Section 3 depicts the altmetric data providers used in this study while the underlying data and method are described in Section 4. Section 5 shows the main findings during the data collection and Section 6 analyses these findings for the single data providers and social media platforms. Section 7 concludes.

2 Related Research

The increasing interest in altmetric analyses is mirrored by a rise of services or tools supporting the collection of altmetric data. These tools share two key characteristics: 1) they are a one-stop-solution for data downloads querying several altmetric data sources (e.g., Twitter, Facebook, Mendeley), and 2) they address non-programmers who wish to get access to altmetric data without having to query the respective APIs of the data providers. There are several services on the Web that offer detailed altmetric survey instruments, e.g., ImpactStory [1], Altmetric Explorer [2], or Webometric Analyst[3]. These services register the online activity of usage, capture, mention, share, citation and diffusion of many types of research output through social media and make them available for download. Some services (e.g., ImpactStory) also provide some context to the registered indicators to facilitate the understanding and comparison of raw data.[4]

The listed services pursue different strategies when gathering altmetric data and do not always disclose how the data is generated exactly. Oftentimes, they make use of unique identifiers for scientific publications like Digital Object Identifiers (DOIs), PubMed ID (PMID), or other unique codes related to researchers (e.g., Open Researcher and Contributor ID (ORCID)) to search for publications on social media platforms (Barbaro, Gentili, & Rebuffi, 2014). Webometric Analyst also employs textual searches for bibliographic information. All approaches suffer from limitations which have to be considered when performing altmetric analyses employing one of these services. Searches based upon identifiers do not return any results when identifiers are erroneous or missing in the respective social media platforms. Textual searches may

1 http://www.impactstory.org
2 http://www.altmetric.com
3 http://lexiurl.wlv.ac.uk
4 http://blog.impactstory.org/31256247948

retrieve duplicates because of textual ambiguity.

When conducting altmetric analyses, these uncertainties can result in challenges to the validity and reliability of results (Konkiel, 2012; Zahedi, Fenner, & Costas, 2014). In Peters et al. (2014) the authors initially explored if and how the scientific output of the multidisciplinary institutes of the Leibniz Association is visible on various social media platforms and can thereby be evaluated based on altmetrics. Altmetric analyses were carried out using Webometric Analyst and ImpactStory. In the course of the evaluation, it became evident that the use of different altmetric instruments can lead to different results.

Chamberlain (2013) also compared the results from altmetrics providers PLOS, ImpactStory, Altmetric.com (Altmetric Explorer) and Plum Analytics for 565 DOIs from PLOS journals. He found that most variability in the providers' data was in PubMed Central citations and PLOS html and pdf views. Moreover, data variation depends on the date the data was downloaded by the providers and also on specific DOIs. Zahedi, Fenner, and Costas (2014) studied altmetric data from PLOS ALM[5], Altmetric.com and Mendeley for 1,000 DOIs from PLOS One journals. More publications with at least one tweet have been found by Altmetric.com, whereas PLOS ALM returned more publications with both at least one Mendeley reader and Facebook mention. Altmetric.com, in sum, found more readers on Mendeley as well as more tweets containing the DOI. However, PLOS ALM received more Facebook mentions. This discovery challenges the reliability of existing instruments for altmetric analyses.

In order to further explore the variations in findings provided by various altmetric services, this study will compare four altmetric data providers, i.e., Webometric Analyst, ImpactStory, Altmetric Explorer, and Plum Analytics[6], using a broad selection of scientific disciplines as represented by the five sections of the Leibniz Association[7], i.e., Humanities and Educational Research (Section A), Economics/ Social Sciences/ Spatial Research (Section B), Life Sciences (Section C), Mathematics/ Natural Sciences/ Engineering (Section D) and Environmental Sciences (Section E). The aim is to find, if and how the results of the instruments are comparable with each other and if it is sufficient to carry out an analysis with only a single data provider, or if it would be better to combine the results of multiple services to get a valid representation of publications in the social Web (Chamberlain, 2013; Konkiel, 2012). We will also focus on disciplinary variations of the data provided by the four pertinent services.

3 Depiction of Altmetric Data Providers

3.1 ImpactStory

ImpactStory is a Web tool for researchers that tracks altmetric data from a variety of different sources such as Mendeley, PLOS, or PubMed Central and for different types of research products, for example journal articles, research data, software code, or blog posts[8]. From each source – if available – several altmetrics are collected to offer a range of indicators that cover diverse aspects of impact. Researchers can set up a profile in order to collect altmetrics for their items of research output. These "impact reports" are presented on a Web site, which can be either used for personal information or can be included in a CV. For detailed analyses, there is a download option. Currently, not all data can be downloaded due to licensing restrictions, although it is displayed on the report page. ImpactStory is a non-profit organization and funded by the Alfred P. Sloan foundation. In the beginning of August ImpactStory announced that they will start to charge authors 10 USD per month (60 USD/year)[9] for using the platform, weekly updates are included as well as the offer to upload new

5 http://article-level-metrics.plos.org

6 http://www.plumanalytics.com

7 http://www.leibniz-gemeinschaft.de/en/home

8 For further information, see the Impact Story FAQ website: https://impactstory.org/faq

9 See the ImpactStory blog post on 15th August 2014: http://blog.impactstory.org/new-pricing/

items. New features and improvements will follow. The reason for turning to such a subscription model is to stay "financially sustainable".

3.2 Altmetric Explorer

Altmetric Explorer is a fee-based Web tool which identifies references and citations from academic publications in the social Web. Besides listing the articles, activities on all articles can be viewed and filtered according to type. An altmetric analysis of journals is also possible. The search can be restricted to specific aspects: e.g., reference period, publishing journal, the publishing company and reference, as well as the Medline subject. The search is based on keywords or identifiers. The Altmetric Explorer allows searches in the respective field of up to 50 DOIs, arXiv IDs, RePEc identifiers, handles, or PubMed IDs. The results of the search can be exported as Excel files and individual searches can be saved as reports. The service offers an API through which the data can be processed. It is also possible to construct individual altmetric score 'donuts' (a visualization typical for Altmetric Explorer).

3.3 Plum Analytics

Plum Analytics is a fee-based service originally founded in 2012 by software engineer Andrea Michalek and librarian Mike Buschman to facilitate altmetric analyses. The service was acquired by EBSCO Information Services in early 2014. Plum allows for analyses of various forms of publications, including journal articles, books, conference proceedings, presentations, or videos. It collects data from more than 25 different information and social media services and aggregates them to five categories of altmetrics: usage, captures, mentions, social media, and citations. The service targets individual researchers as well as departments or institutions. Researchers can generate personal profile on the service's PlumX platform to visualize and display their research impact. PlumX also offers a widget that can be integrated into institutional repositories, Web sites and online journals to facilitate altmetrics/article level metrics analyses.

3.4 Webometric Analyst

Webometric Analyst (Thelwall, 2009) is a free, downloadable software package that allows users to search Mendeley with either a list of DOIs or with bibliographic information on publications (e.g., name of first author, publication year, publication title, etc.). Mendeley-searches return the number of readers for the particular DOI and the top 3 of each country, career stage, and discipline of readers as declared in the reader profiles. Webometric Analyst can also be used to search with DOIs in Altmetric Explorer-data to receive readership information from Mendeley but also further altmetric indicators as described above. However, Webometric Analyst states that searches in Altmetric Explorer run faster when a commercial API key has been entered. To distinguish both search options in our analysis we term the first option "Mendeley@Webometric Analyst" and the second option "Altmetric Explorer@Webometric Analyst".

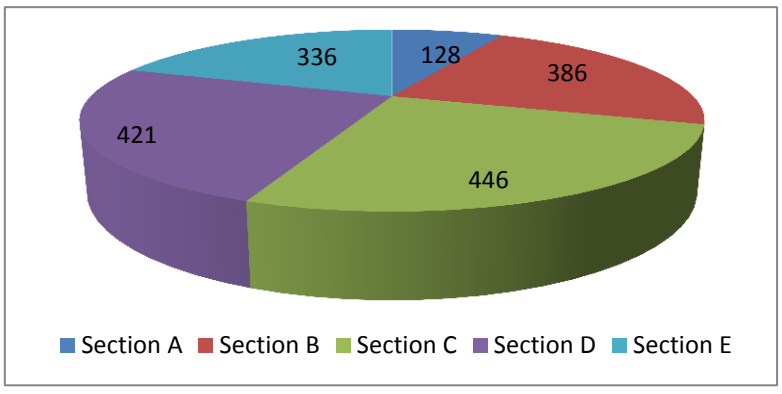

Figure 1: Distribution of DOIs across disciplines in searched data set (absolute numbers, n=1,717).

4 Data & Method

The aim of the study is to test the altmetric analyses provided by the four services on the same multidisciplinary data set to find out which services allows for the most comprehensive analysis. Since it has been shown that altmetric data quality varies between disciplines (e.g., Holmberg & Thelwall, 2014) the test data set was chosen to cover a wide range of scholarly publications. As described in Peters et al. (2014) the Leibniz Association comprises research institutions of all disciplines and thus provides an ideal case for our analysis. The institutions are allocated to five so-called sections representing the following disciplines: a) Humanities and Educational Research, b) Economics, Social Sciences, Spatial Research, c) Life Sciences, d) Mathematics, Natural Sciences, Engineering, and e) Environmental Sciences. From the institutions we retrieved publications of the years 2011 and 2012 and manually validated 1,740 DOIs [10]. Duplicates (i.e., 23 DOIs across all disciplines) in the initial DOI set were removed before downloading altmetric data. DOIs (instead of textual information or other persistent identifiers) were chosen as queries since all data providers offer DOI search options. The distribution of DOIs across disciplines in the data set is shown in Figure 1. The sets of DOIs per discipline are comparable in size, although there are considerably less DOIs in the Humanities and Educational Research due to little use of DOIs in this field.

In order to collect comparable altmetric data, all providers were queried for the same set of DOIs on the same day (i.e., August 8th 2014)[11].

5. Findings during Data Collection

5.1 Challenges and Problems of Single Tools

While using the tools we encountered several problems and limitations, most of them were of technical nature. ImpactStory proved to be unreliable with regard to its "delete" functionality. Since the tool's main purpose is to provide a platform for authors to set up a personal profile that contains their publications along with their different altmetrics, only single items can be delete from the list. This proved to be problematic since we had – in order to conduct the analysis – to insert the list of DOIs section by section due to capacity restrictions of ImpactStory. Furthermore, we experienced that ImpactStory actually kept older DOIs although these had been already deleted, therefore the tables for each section had to be checked and cleaned to make sure that the results only contain DOIs from the specific section. In several cases, uploading the bulk of DOIs took quite a while and produced several error messages; this is why the whole process of collecting altmetric for each section was quite laborious. In several cases, the publication profile list contained less information than the item's details page and the downloaded Excel spreadsheet. For some items on the list, ImpactStory did not display the title of a specific DOI although the detail's page and downloaded Excel spreadsheet contained the title along with its altmetrics' counts (see Figure 2). ImpactStory collects a wide range of altmetrics from various data sources or providers [12], but these are not always available for each article. The main reason is that not every article is mentioned in one of these data sources, but there are also gaps (zero values) if ImpactStory is not able to collect some of the metrics due to licencing reasons or is not able to find the DOI.

10 A more detailed description of the data set can be found in Peters et al. (2014)

11 Due to software problems data from Webometric Analyst was downloaded on August 12, 2014

12 See help files for further details https://impactstory.org/faq

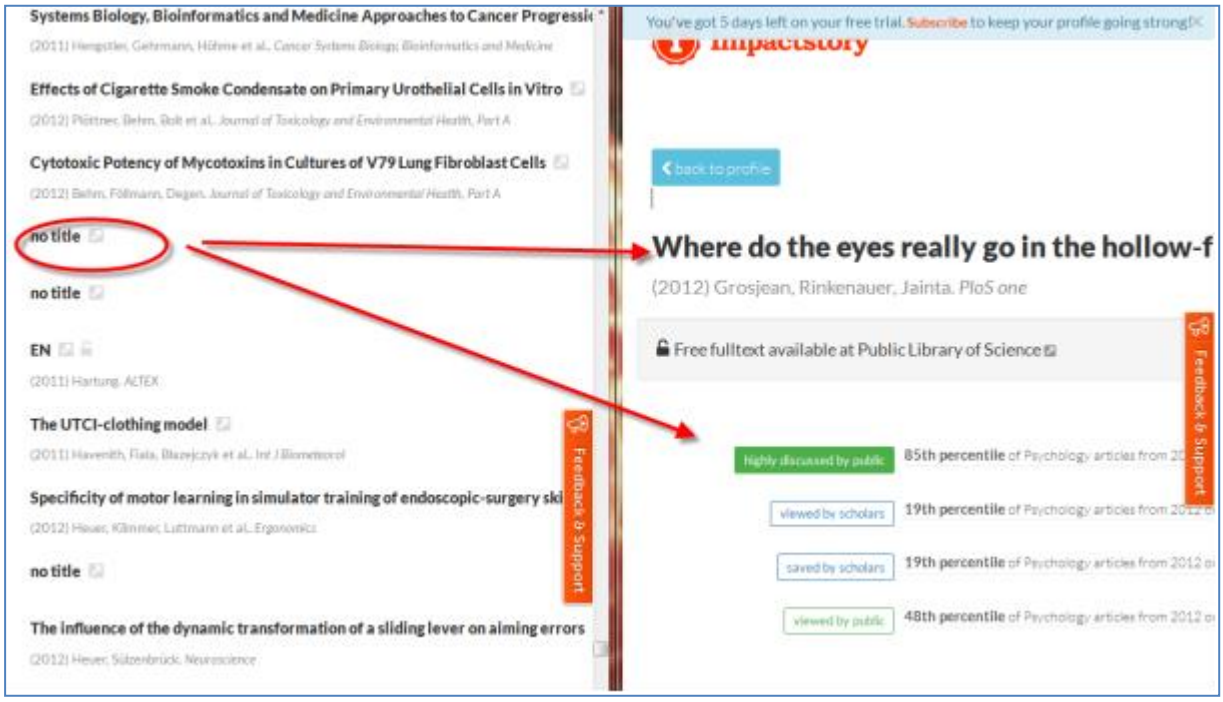

Figure 2. Different information in the title list and on the item's details page.

Plum Analytics offers interested institutions a free trial account. In addition, trial users can refer to an EBSCO customer service representative in case of questions. Plum allows for the upload of an extensive list of DOIs and generates downloadable search results in various data formats. No difficulties were encountered in the use of the service.

Webometric Analyst requires a Microsoft Azure Account key[13] to perform data collection and also only runs on Microsoft systems. It restricts data download from Mendeley to 500 items per hour, which has to be considered in altmetric studies. The search with Altmetric Explorer data runs faster if an Altmetric Explorer API key was entered.

Altmetric Explorer itself can only process a maximum of 50 identifiers at one time. Identifiers have to be numeric, thus, the link format, e.g., http://dx.doi.org, has to be removed from the data before analyses. If searching for articles with DOIs altmetric data has to be immediately exported, because the results cannot be saved. Only the search process with the respective settings can be saved under /my Workflow/. Therefore, Altmetric Explorer is only suitable for an immediate analysis with real-time data.

5.2 Comparison of Altmetric Indicators Found via Tools

Table 1 provides an overview of the metrics generated by the different services (see also Konkiel, 2012). The table shows the metrics included in the reports generated based on our data set, even if the value was "0" for some platforms. For example, ImpactStory collects metrics from arXiv or Figshare, but no metrics were provided for our data set. Altmetric Explorer collects metrics from Q&A sites and Weibo, but in our data sets no counts for both are provided. While conducting the analyses, we found that not all the metrics mentioned below were covered in the data reports for each discipline. For example, ImpactStory only retrieved Wikipedia mentions for DOIs from the Leibniz Sections C, D, E (not shown in the table). Presumably, no metrics are available for the DOIs in the respective missing sections. While Table 1 provides an overview of the available metrics per service as represented in our data set, Table 2 shows the actual number of DOIs found for each metric (coverage) and per Leibniz section. Finally, Table 3 reports the

13 http://lexiurl.wlv.ac.uk/searcher/AzureKey.html

impact metrics generated per service and per Leibniz section.

We find that Plum Analytics provides the most detailed altmetric data, covering many data sources and collecting different altmetrics from each source. Other services tend to collect only one metric per data source (e.g., just Mendeley readers and no Mendeley groups). Altmetric Explorer focuses on "standard" social media platforms such as Mendeley, Facebook, or Twitter, but does not include metrics from publication Web sites or databases such as PLOS or PubMed Central. The remaining data providers collect a range of different metrics, except for Webometric Analyst which only covers Mendeley readers (when it is not drawing upon Altmetric Explorer data). In some cases, the data providers draw some of their metrics from aggregated data sources. For example, ImpactStory draws data on blog posts, Facebook posts, and Twitter tweets from Altmetric.com (Altmetric Explorer). In these instances, we expect similar results across services. Plum Analytics draws Twitter data from Topsy.com. For the sake of comparability, we will focus the ensuing analysis (see paragraph 6) on those metrics that have been found by at least two services. Therefore, some platforms, such as SSRN or EBSCO, will be excluded from the analysis. Moreover, some metrics, such as Facebook and Google+ activities (e.g., likes, shares, comments), will be subsumed under one metric representing all Facebook affordances.

Table 1. Metrics covered by different data sources for our data set.

Data Source		Plum Analytics	ImpactStory	Altmetric Explorer	Mendeley@ Webometric Analyst	Altmetric Explorer@ Webometric Analyst
EBSCO	Clicks	x				
	Abstract Views	x				
	HTML Views	x				
	PDF Views	x				
	Data Views	x				
SSRN	Abstract Views	x				
	Downloads	x				
	Citations	x				
Scopus	Citations	x				
PLOS	HTML Views	x	x			
	PDF Views	x	x			
Mendeley	Groups	x				
	Readers	x	x	x	x	x
PubMed Central	HTML Views	x				
	PDF Views	x				
	Citations	x	x			
CrossRef	Citations	x				
Peer review Sites (e.g., F1000)	Reviews			x		x
CiteULike	Readers			x		x
Delicious	Bookmarks	x	x			
Reddit	Scores	x		x		x
	Comments	x				
Facebook	Likes	x				
	Comments	x				
	Shares (wall posts)	x	x	x		x
Twitter	Tweets	x	x	x		x
Google+	"+1s"/Shares		x	x		x
Wikipedia	Links	x				
	Mentions		x			
Pinterest	Posts			x		x
Blogs	Posts		x	x		x
News	Citations			x		
Q+A sites	Citations			x		x
Policy Documents	References			x		

6. Results: Coverage and Impact

Our analysis will focus on both coverage and impact: In a first step, we will compare the coverage of publications on social media platforms found by the four services across disciplines. In a second step, we will take a closer look at the actual impact of the publications as measured by the four services for all disciplines.

6.1 Coverage

As mentioned above, we find that Plum Analytics provides the widest selection of altmetrics with 26 different metrics covered by the analysis (see Table 1). ImpactStory and Altmetric Explorer both provide data on 12 metrics, while Webometric Analyst only generates one metric (Mendeley Readers), except for queries tapping Altmetric Explorer, in which case eight additional metrics are provided.

As to the coverage of the DOIs included in the data set (Table 3), we find that Webometric Analyst results are in fact identical with those of the Altmetric Explorer if the query taps this service. Since without this inclusion, the Webometric Analyst only generates Mendeley Reader data, in this comparison Webometric Analyst can only be included to a very limited degree.

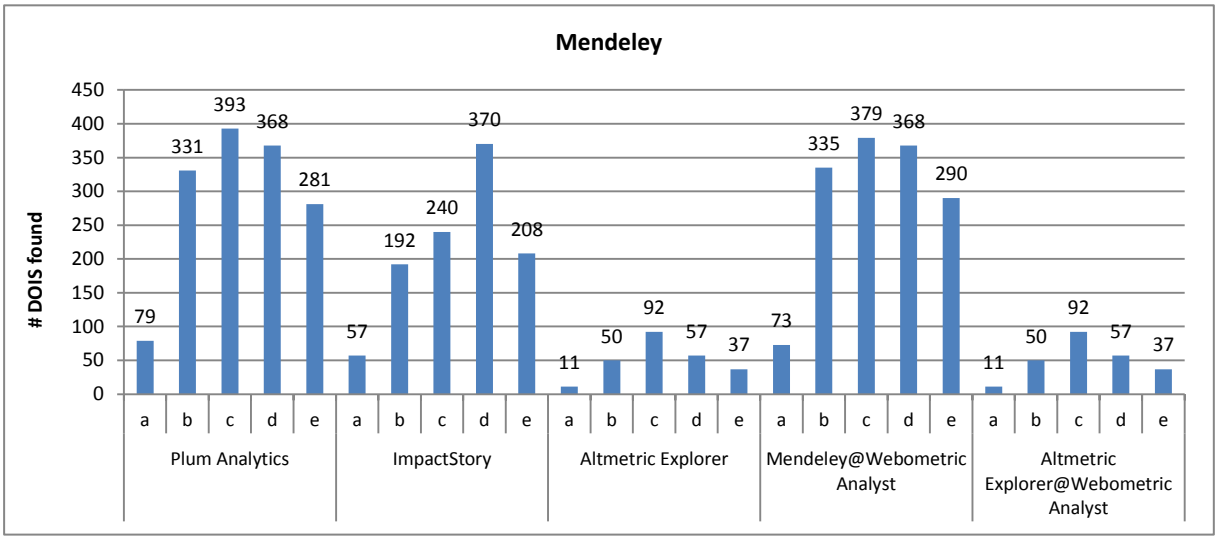

Figure 3. Coverage of DOIs on Mendeley for each section found by the data providers. The Leibniz sections are a) Humanities and Educational Research, b) Economics, Social Sciences, Spatial Research, c) Life Sciences, d) Mathematics, Natural Sciences, Engineering, and e) Environmental Sciences (n=1,717).

Plum Analytics (total of DOIs found: 1,452) and Webometric Analyst (1,445 DOIs) appear to provide the best coverage of Mendeley, followed by ImpactStory (1,067 DOIs) (see Figure 3). The Altmetric Explorer only identifies a fraction of the DOIs identified by the other services (247 DOIs). Interestingly, Plum Analytics and ImpactStory generate quite similar data for publications from Sections D (Mathematics, Natural Sciences, Engineering) and E (Environmental Sciences), while the other sections appear underrepresented by ImpactStory.

Twitter is best covered by Altmetric Explorer and ImpactStory, while Plum Analytics only generates data for one DOI (see Figure 4). Facebook, instead is best covered by Plum Analytics, with only occasional results by ImpactStory (see Figure 5). Wikipedia is equally covered by Plum Analytics and ImpactStory, but not represented by the other services.

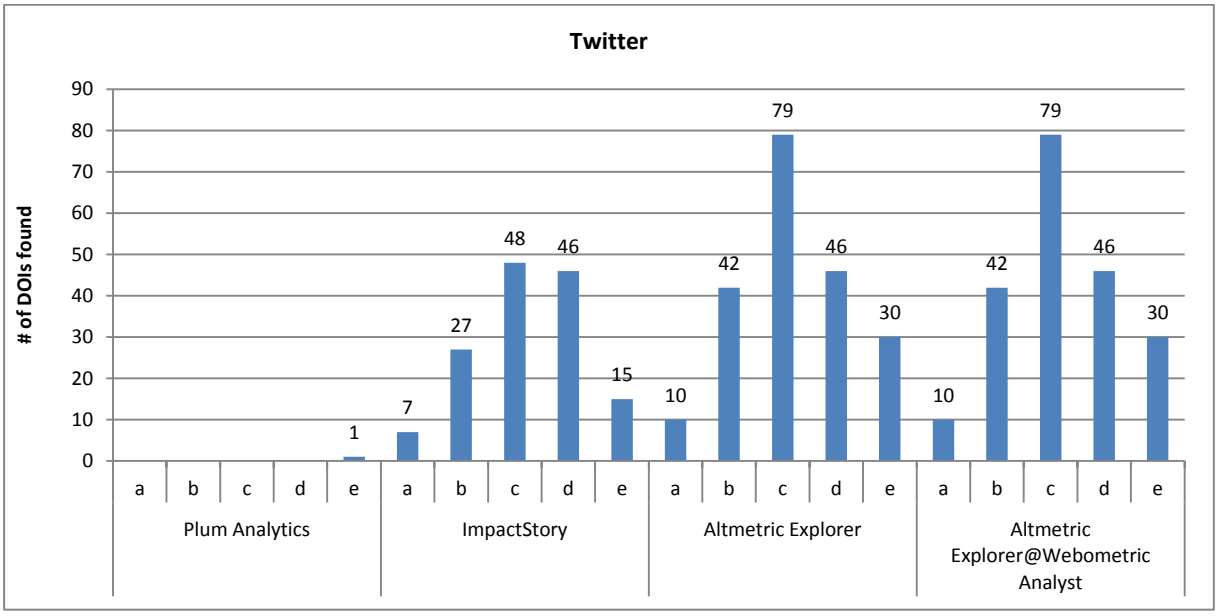

Figure 4. Coverage of DOIs on Twitter for each section found by the data providers. The Leibniz sections are a) Humanities and Educational Research, b) Economics, Social Sciences, Spatial Research, c) Life Sciences, d) Mathematics, Natural Sciences, Engineering, and e) Environmental Sciences (n=1,717).

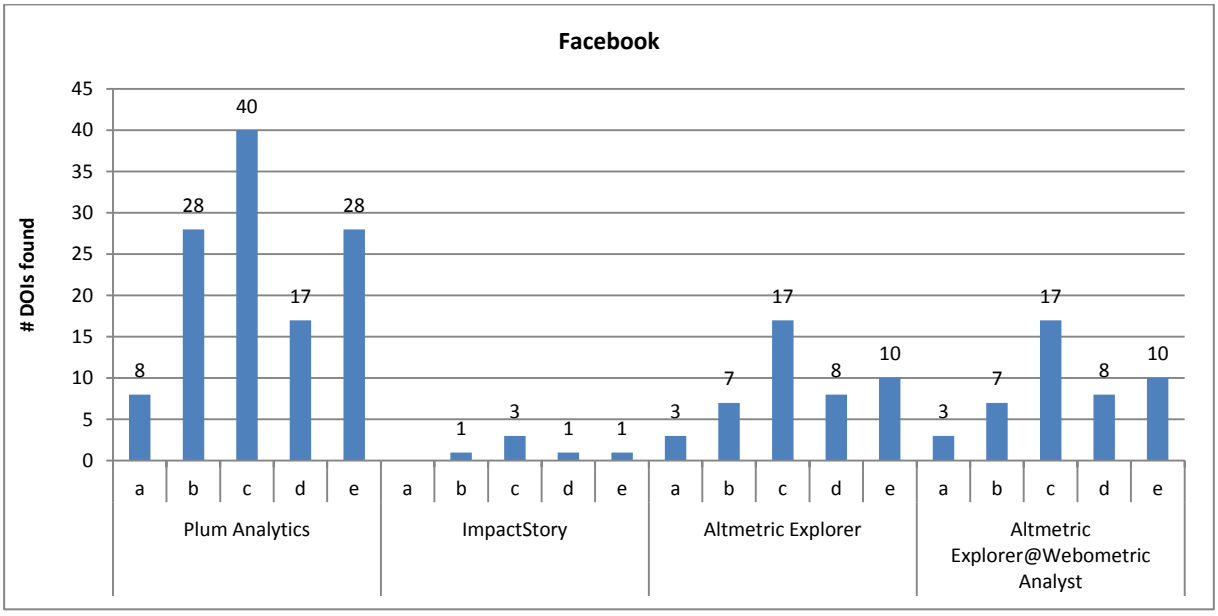

Figure 5. Coverage of DOIs on Facebook for each section found by the data providers. The Leibniz sections are a) Humanities and Educational Research, b) Economics, Social Sciences, Spatial Research, c) Life Sciences, d) Mathematics, Natural Sciences, Engineering, and e) Environmental Sciences (n=1,717).

When looking at PubMed citations, PLOS HTML views and PLOS PDF views, Plum Analytics clearly provides a more comprehensive coverage than ImpactStory – unsurprisingly, this is most clearly the case for Section C (Life Sciences) (see Figure 6). The other altmetric tools do not provide data on these metrics. However, it is striking that the most DOIs have been found for PubMed citations, i.e. 398 publications across all disciplines via Plum Analytics and 312 via ImpactStory. That means that 398 and 312 publications respectively have been cited at least once on PubMed which is most likely due to the broader coverage of PubMed in general (PLOS HTML/PDFs views are only available for PLOS articles).

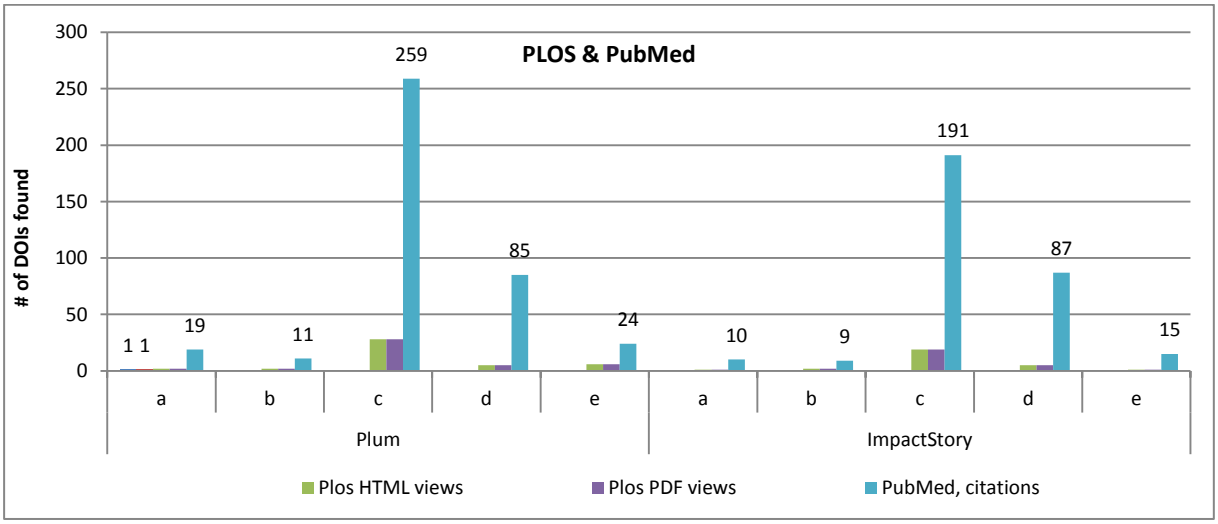

Figure 6. Coverage of DOIs on PubMed and PLOS for each section found by the data providers. The Leibniz sections are a) Humanities and Educational Research, b) Economics, Social Sciences, Spatial Research, c) Life Sciences, d) Mathematics, Natural Sciences, Engineering, and e) Environmental Sciences (n=1,717).

The other services do not provide these metrics at all. CiteULike and F1000 seem to be best covered by Altmetric Explorer, while Google+ is best covered by Plum Analytics – but overall, only few DOIs where found for these metrics (see Figure 7).

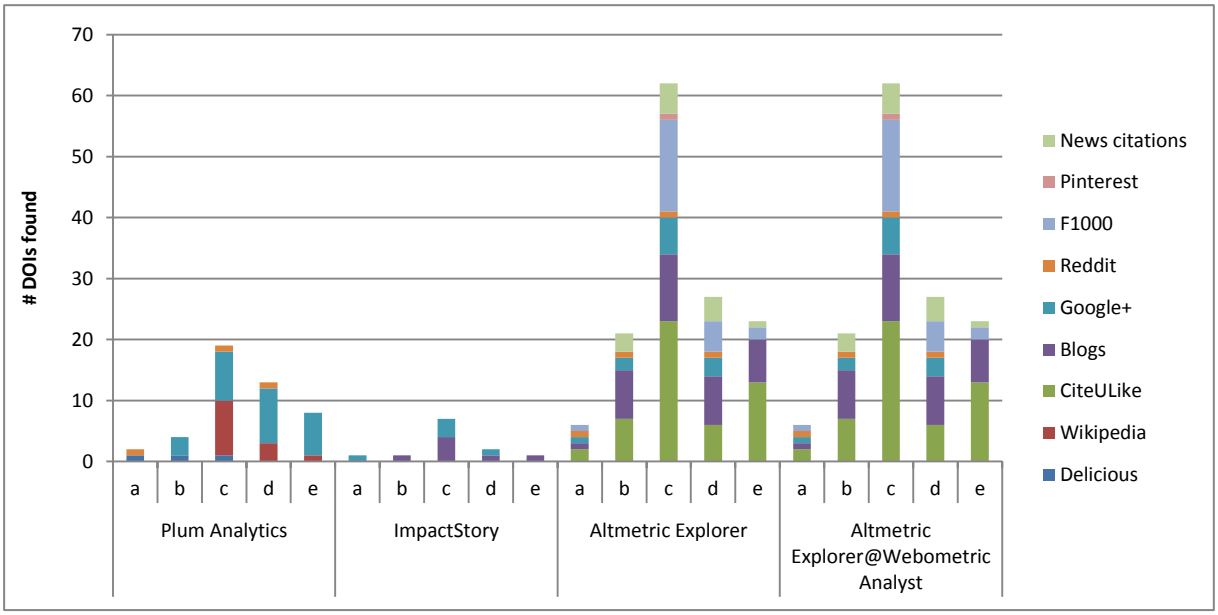

Figure 7. Coverage of DOIs on various social media platforms for each section found by the data providers. The Leibniz sections are a) Humanities and Educational Research, b) Economics, Social Sciences, Spatial Research, c) Life Sciences, d) Mathematics, Natural Sciences, Engineering, and e) Environmental Sciences (absolute numbers; n=1,717).

Since the highest coverage of the publications included in the data set can be found on Mendeley, and the Altmetric Explorer's coverage of Mendeley is incomprehensive, this service displays the lowest overall coverage (even lower than Webometric Analyst, which does cover Mendeley fairly comprehensively). On the other hand, Altmetric Explorer performs

very well in its coverage of platforms such as Twitter, CiteULike, Blogs, Google+, Reddit, F1000, or Pinterest. Given that these platforms do not directly focus on academic use cases (except for F1000 and CiteULike) it is surprising that at least some DOIs have been found here. However, Altmetric Explorer's poor performance on the Mendeley search results in the worst overall coverage values of our comparison. But, if the Altmetric Explorer would improve its coverage of Mendeley, it would provide the most comprehensive coverage of metrics of today's pertinent social media platforms.

Despite its under-coverage of Twitter, Plum Analytics currently provides the most comprehensive overall coverage, with notable strengths in its coverage of Mendeley, Facebook, Wikipedia, and Google+.

6.2 Impact

After having discussed the coverage of the data set on the various platforms as found by the four data providers, we will now take a closer look at the impact values provided by Plum Analytics, ImpactStory, Altmetric Explorer and Webometric Analyst (see also Appendix: Table 3).

As discussed above, the number of Mendeley readers is the only altmetric data that is provided by all data providers across all sections in our data set (see Figure 8). Again, the Webometric Analyst reports the highest reader numbers for Mendeley, followed by Plum Analytics. ImpactStory only reports a comparable impact for Section D (Mathematics, Natural Sciences, Engineering), but underreports the impact for other sections, particularly Sections B (Economics, Social Sciences, Spatial Research) and E (Environmental Sciences). Mirroring its lack of coverage, the Altmetric Explorer significantly underreports the impact for Mendeley.

Despite the differences in impact reported per service, the patterns uncovered by Plum Analytics, ImpactStory and Webometric Analyst are very similar: publications from sections C and E attract most Mendeley Readers. Only a small amount of readers can be counted for the Arts & Humanities Section A. The total number of Mendeley readers is in line with the number of DOIs covered by the services per platform.

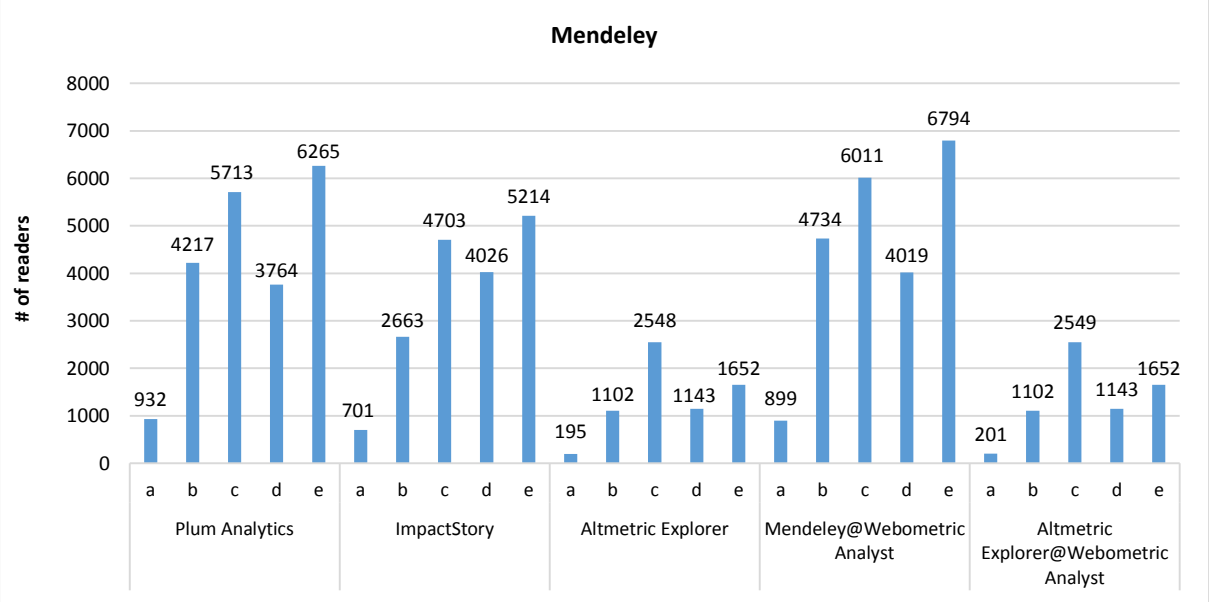

Figure 8. Total count of Mendeley readers for each section found by the data providers. The Leibniz sections are a) Humanities and Educational Research, b) Economics, Social Sciences, Spatial Research, c) Life Sciences, d) Mathematics, Natural Sciences, Engineering, and e) Environmental Sciences.

On the other hand, Altmetric Explorer reports the highest impact values for Twitter, followed by ImpactStory (see Figure 9). If these data can be considered accurate, a sizeable impact of the publications in the data set on Twitter can be identified. As discussed above, Plum Analytics only got data for a single section (Section E). Again, for those data providers that offer Twitter data across all sections, the pattern is similar: Most of the activities are related to Section C (Life Sciences).

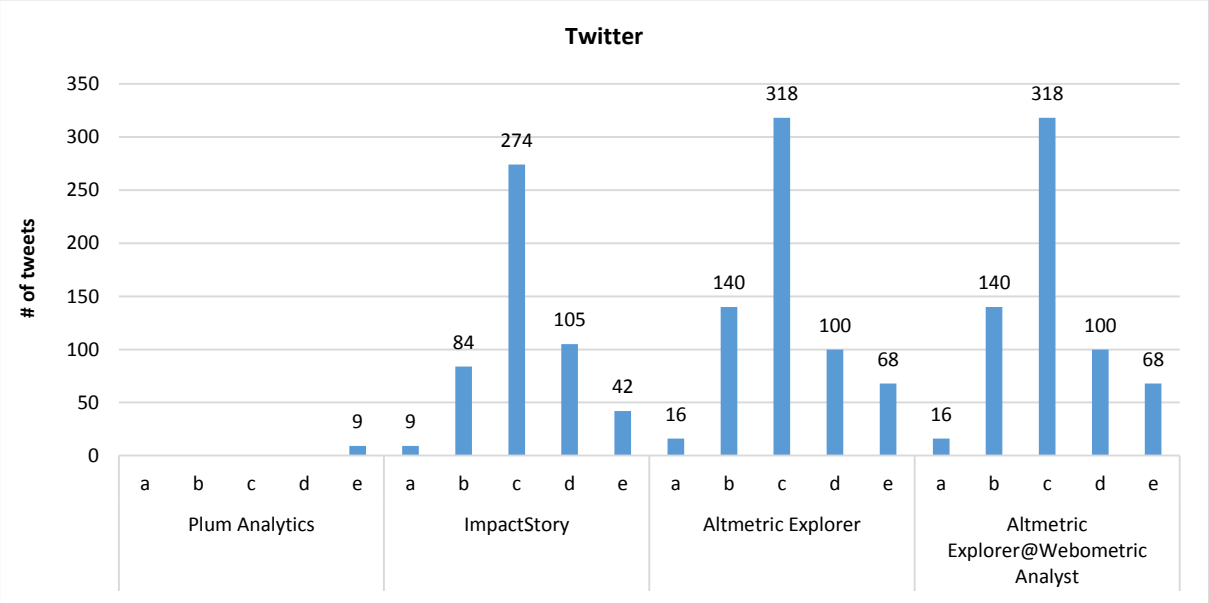

Figure 9. Twitter counts for each section found by the data providers. The Leibniz sections are a) Humanities and Educational Research, b) Economics, Social Sciences, Spatial Research, c) Life Sciences, d) Mathematics, Natural Sciences, Engineering, and e) Environmental Sciences.

Somewhat surprisingly, Plum Analytics reveals even stronger impact values of the publications included in the data set on Facebook (Figure 10). Together, they generate more than 1,500 likes, shares, or comments on Facebook. This would imply that Facebook should be considered at least as important a platform to estimate impact of scientific publications as Twitter. Notably, the other services barely register any impact on Facebook at all. Sections C and E (Life Sciences and Environmental Sciences) outnumber the other sections with regard to impact as measured by Facebook affordances.

When looking at platforms such as CiteULike, Blogs, Google+, Reddit, F1000, or Pinterest, the Altmetric Explorer reports the highest overall impact, followed by Plum Analytics (see Figure 11). Yet, except maybe for CiteULike and Blogs, these platforms do not register a sizeable impact of the publications included in the data set, ranging in up to only 100 instances of user reactions.

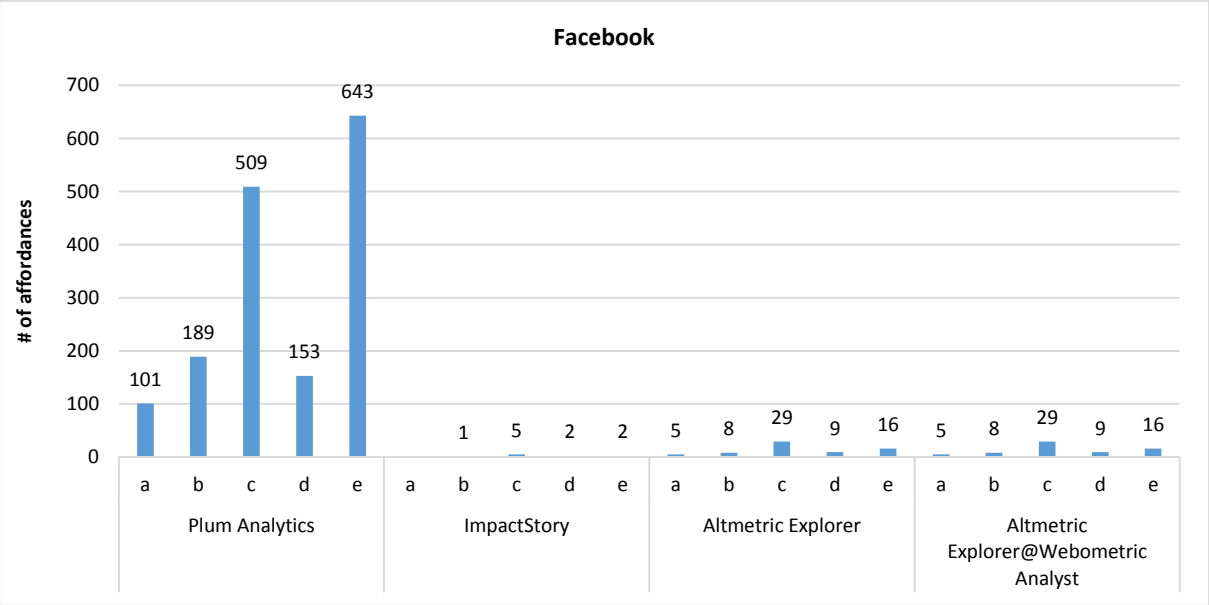

Figure 10. Facebook affordances for each section found by data providers. The Leibniz sections are a) Humanities and Educational Research, b) Economics, Social Sciences, Spatial Research, c) Life Sciences, d) Mathematics, Natural Sciences, Engineering, and e) Environmental Sciences.

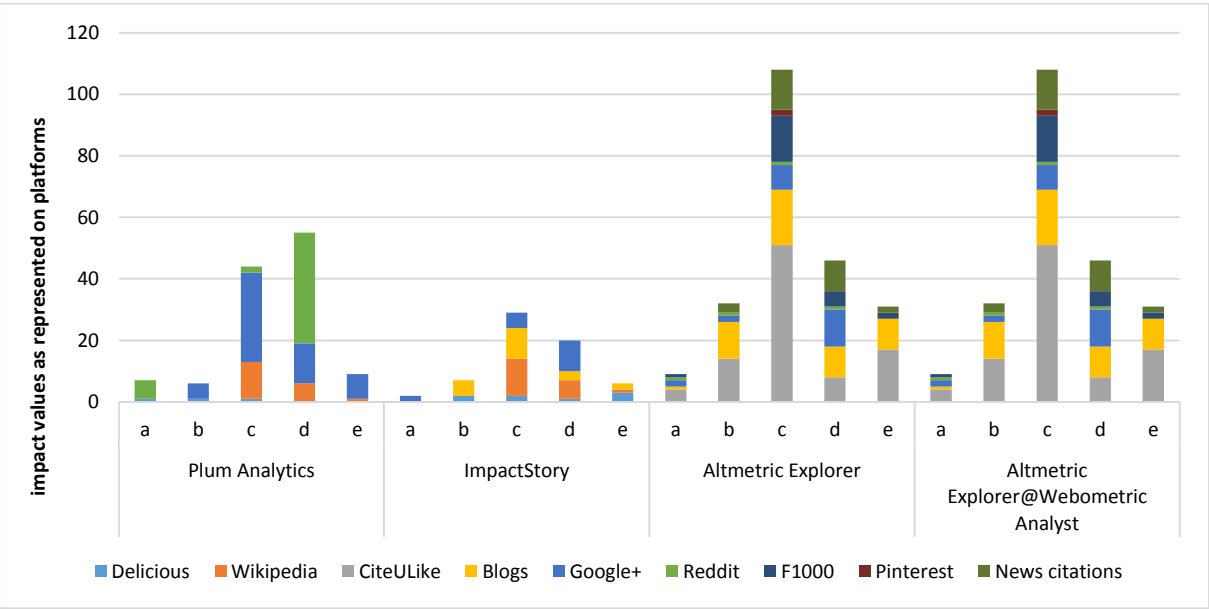

Figure 11. Altmetrics from various data sources grouped by section and data providers. The Leibniz sections are a) Humanities and Educational Research, b) Economics, Social Sciences, Spatial Research, c) Life Sciences, d) Mathematics, Natural Sciences, Engineering, and e) Environmental Sciences.

Highest impact values on PubMed and PLOS are captured by Plum Analytics (see Figure 12). Only ImpactStory covers these platforms, too, but it clearly underreports the impact generated in Sections A (Humanities and Educational Research), C (Life Sciences), and E (Environmental Sciences). Comparing the impact as reported by the two services to their coverage of DOIs (see Appendix: Table 2), we see that the impact is closely in line with the coverage (see Appendix: Table 3). Nevertheless, often only a single or only a few DOIs are responsible for the overall impact of that section. Plum Analytics for example

covers only two DOIs in Section B but tracks 4,553 PLOS HTML and 740 PLOS PDF views for both of them. Sections C and E generate most of the attention on these services, which is not surprising because PubMed Central is a database for articles from the life sciences and PLOS a platform for publications from the natural sciences.

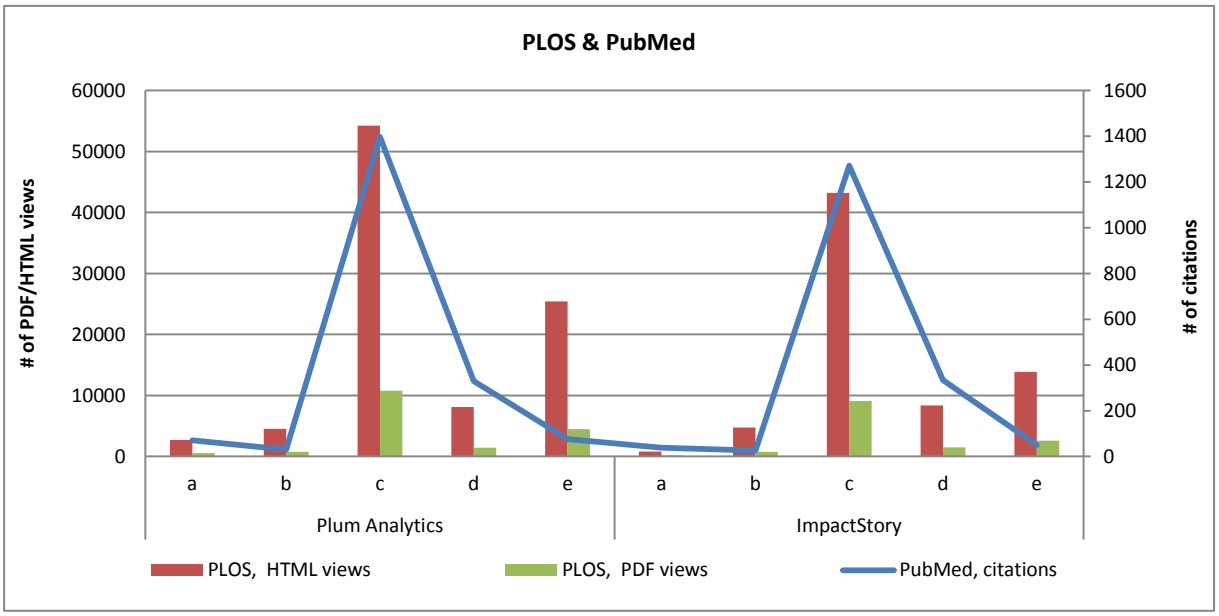

Figure 12. Comparison of PubMed citations and PLOS views for Plum Analytics and ImpactStory across the different Leibniz sections: a) Humanities and Educational Research, b) Economics, Social Sciences, Spatial Research, c) Life Sciences, d) Mathematics, Natural Sciences, Engineering, and e) Environmental Sciences.

Given that some services reference each other, some deviations between the reported impact values per service appear somewhat puzzling: ImpactStory reportedly refers to Altmetric Explorer for Twitter, Facebook and blogs data, yet the results of both services differ significantly. On the other hand, there are only minute differences in Mendeley readers between Altmetric Explorer and the Webometric Analyst query of Altmetric Explorer. The slight difference might be the result of the four days later data download with Altmetric Explorer@Webometric Analyst. Although this result might have been expected - given that both search options queried the same data provider, i.e. Altmetric Explorer - having the evidence is a pleasant outcome of the study.

7 Conclusion

One of the main results of our study is that for same data sources the coverage and metric counts (impact) can vary on several levels across the studied data providers. First, the data providers fetch altmetric data from different social media platforms and with varying detailedness (e.g., Plum Analytics retrieves Facebook likes, comments, and shares, whereas ImpactStory only collects number of shares). Out of the studied data providers, Plum Analytics registers the most metrics for the most platforms. Second, the data providers differ in the number of DOIs they find on the social media platforms. Especially in the case of Mendeley, Altmetric Explorer performs worst in retrieving readership information for DOIs which has also been the case in the study performed by Zahedi, Fenner and Costas (2014). Third, the altmetric impact values provided by Plum Analytics, ImpactStory, Altmetric Explorer, and Webometric Analyst for the publications in the data set also considerably deviate. Oftentimes it is the Altmetric Explorer search which results in lower impact values.

When comparing the “performance” of the different services with regard to our data set,

Plum Analytics seems to be “better” in tracking Facebook posts, whereas AltmetricExplorer and Altmetric Explorer@Webometric Analyst find more mentions on Twitter. The latter track almost the same results for several altmetric tools and are therefore “interchangeable”, which means that is sufficient to consult only one of them. For counting Mendeley readers, Mendeley@Webometric Analyst seems to track higher counts than all the other services used in our study. Even if it was not the focus of our study, when comparing the overall impact publications from the STM subject areas attract more attention on various social media platforms (or are better findable by data providers) than those from the Arts & Humanities or Social Sciences.

Although the data providers also cooperate in altmetric data collection, the results for shared metrics may differ. ImpactStory, for example, receives metrics for blog posts, Facebook public posts, and Twitter tweets from Altmetric.com, which is actually the Altmetric Explorer used in this study, but the results bear hardly any similarity. Only the relation between the number of covered DOIs and the respective metrics’ count is comparable. This raises the question how the different data providers actually collect the metrics’ values and how often they are updated (Zahedi, Fenner, & Costas, 2014).

Future work will comprise a more detailed comparison of counts for coverage and impact for DOIs found by all data providers to reveal more details on the challenges in altmetric data collection.

Acknowledgements

We would like to thank Anita Eppelin and Steffen Lemke for their assistance in the data collection. The study is part of the research conducted within the Leibniz Research Alliance Science 2.0 (http://www.leibniz-science20.de/en).

References

Barbaro, A., Gentili, D., & Rebuffi, C. (2014). Altmetrics as new indicators of scientific impact. JEAHIL, 10(1), 3-6.

Chamberlain, S. (2013). Consuming article-level metrics: Observations and lessons from comparing aggregator provider. Information Standards Quarterly, 25 (2), pp. 4-13.

Haustein, S., Peters, I., Sugimoto, C.R., Thelwall, M., & Larivière, V. (2014). Tweeting biomedicine: An analysis of tweets and citations in the biomedical literature. Journal of the Association for Information Science and Technology, 65(4), 656–669.

Holmberg, K., & Thelwall, M. (2014). Disciplinary differences in Twitter scholarly communication. Scientometrics, DOI: 10.1007/s11192-014-1229-3

Konkiel, S. (2012). Robust 'altmetrics' as a framework for measuring item usage and researcher impact in institutional repositories. Poster presentation at 2012 LITA National Forum. Columbus, OH, USA. 5-7 October 2012

Peters, I., Jobmann, A., Eppelin, A., Hoffmann, C. P., Künne, S., & Wollnik-Korn, G. (2014). Altmetrics for large, interdisciplinary research groups: A case study of the Leibniz Association. In Proceedings of Libraries in the Digital Age, Zadar, Croatia. Retrieved from http://ozk.unizd.hr/proceedings/index.php/lida/article/view/162/138

Priem, J., Taraborelli, D., Groth, P., & Neylon, C. (2011). Altmetrics: A manifesto. Version 1.01, September 28, 2011. Retrieved from altmetrics.org/manifesto

Thelwall, M. (2009). Introduction to Webometrics: Quantitative Web Research for the Social Sciences. San Rafael, CA: Morgan & Claypool.

Zahedi, Z., Fenner, M., & Costas, R. (2014). How consistent are altmetrics providers? Study of 1000 PLOS ONE publications using the PLOS ALM, Mendeley and Altmetric.com APIs. In: altmetrics 14. Workshop at the Web Science Conference, Bloomington, USA.

Appendix

Table 2. Coverage of DOIs retrieved from different data providers. The Leibniz sections are a) Humanities and Educational Research, b) Economics, Social Sciences, Spatial Research, c) Life Sciences, d) Mathematics, Natural Sciences, Engineering, and e) Environmental Sciences.

	Number of retrieved DOIs (coverage)																									
Social Media-Tools	Plum Analytics					ImpactStory					Altmetric Explorer					Mendeley@Webometric Analyst					Altmetric Explorer@ Webometric Analyst				
Leibniz sections	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Mendeley	79	331	393	368	281	57	192	240	370	208	11	50	92	57	37	73	335	379	368	290	11	50	92	57	37
Twitter					1	7	27	48	46	15	10	42	79	46	30						10	42	79	46	30
Facebook	8	28	40	17	28		1	3	1	1	3	7	17	8	10						3	7	17	8	10
Delicious	1	1	1				2	2	1	3															
Wikipedia			9	3	1			9	3	1															
PubMed, HTML views	2	2	28	5	6																				
PubMed, PDF views	2	2	28	5	6																				
PubMed, citations	19	11	259	85	24	10	9	191	87	15															
PLOS, HTML views	2	2	28	5	6	1	2	19	5	1															
PLOS, PDF views	2	2	28	5	6	1	2	19	5	1															
CiteULike											2	7	23	6	13						2	7	23	6	13
Blogs							1	4	1	1	1	8	11	8	7						1	8	11	8	7
Google+		3	8	9	7	1		3	1		1	2	6	3							1	2	6	3	
Reddit	1		1	1							1	1	1	1							1	1	1	1	
F1000											1		15	5	2						1		15	5	2
Pinterest													1										1		
News citations												3	5	4	1							3	5	4	1
Peer review sites													1	2											
Policy Document															2										

Table 3. Impact of DOIs retrieved from different data providers. The Leibniz sections are a) Humanities and Educational Research, b) Economics, Social Sciences, Spatial Research, c) Life Sciences, d) Mathematics, Natural Sciences, Engineering, and e) Environmental Sciences

	Altmetric counts (impact)																								
Social Media-Tools	Plum Analytics					ImpactStory					Altmetric Explorer					Mendeley@Webometric Analyst					Altmetric Explorer@ Webometric Analyst				
Leibniz sections	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Mendeley	932	4217	5713	3764	6265	701	2663	4703	4026	5214	195	1102	2548	1143	1652	899	4734	6011	4019	6794	201	1102	2549	1143	1652
Twitter					9	9	84	274	105	42	16	140	318	100	68						16	140	318	100	68
Facebook	101	189	509	153	643		1	5	2	2	5	8	29	9	16						5	8	29	9	16
Delicious	1	1	1				2	2	1	3															
Wikipedia			12	6	1			12	6	1															
PubMed, HTML views	606	252	11809	1890	1470																				
PubMed, PDF views	199	91	5153	749	524																				
PubMed, citations	71	30	1398	329	76	39	26	1272	334	50															
PLOS, HTML views	2725	4553	54238	8109	25453	834	4731	43211	8361	13894															
PLOS, PDF views	534	740	10808	1455	4497	187	748	9101	1479	2610															
CiteULike											4	14	51	8	17						4	14	51	8	17
Blogs							5	10	3	2	1	12	18	10	10						1	12	18	10	10
Google+		5	29	13	8	2		5	10		2	2	8	12							2	2	8	12	
Reddit	6		2	36							1	1	1	1							1	1	1	1	
F1000											1		15	5	2						1		15	5	2
Pinterest													2										2		
News citations												3	13	10	2							3	13	10	2
Peer Review Sites													1	2											
Policy Documents															2										