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Conference Paper

Research Data Explored II: the Anatomy and Reception of figshare

Research Data Explored II: the Anatomy and Reception of figshare[1]

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Introduction

We are currently witnessing a change in scholarly communication. Next to the paper, complementary materials, such as research data, source code, and images are regarded as important outcomes that should be shared and built upon (Kraker et al., 2011). In this new ecosystem, many archives have been established that cater to the needs of a digital and open science. With the increasing importance of research data in the last years, these archives are now receiving initial interest from bibliometrics research.

Torres-Salinas et al. (2013 & 2014) have performed first coverage and citation analyses of research data in Data Citation Index (DCI). Their results have been corroborated by a further study performed by the authors of this paper (Peters et al., 2015). We found that while research data remain mostly uncited (about 85%), there has been a growing trend in citing data sets published since 2008. We have also studied the frequency of altmetrics scores for cited research data. The results show that the number of cited research data with altmetrics "foot-prints" is even lower (4 to 9%) but hint at a higher coverage of research data from the last decade. However, no relationship between the number of citations and the total number of altmetrics scores could be observed. Certain data types (i.e. survey, aggregate data, and sequence data) are more often cited and do receive higher altmetrics scores, but results vary depending on the research field. One of the more surprising results of our first study was that none of the items from figshare, which is one of the largest multidisciplinary repositories for research materials to date, has received more than one citation in the DCI.

In this paper, we investigate figshare (http://figshare.com) more deeply. For this purpose, we analysed the structure of items archived in figshare, their usage, and their reception in two altmetrics sources with a focus on datasets and filesets. Specifically, we addressed the following questions:

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- How are document types distributed in figshare? How have different types developed over time? Who are the main providers of items in figshare?
- How are usage data distributed in figshare? How are they correlated?
- To what extent are figshare items visible on various altmetrics channels? Do results from providers of altmetric scores (e.g., PlumX) differ?

Data source

Three different data sources were used in this study: (i) figshare, (ii) PlumX and (iii) ImpactStory. figshare is a multidisciplinary repository for research materials that was founded by Mark Hahnel in 2011; it has subsequently been supported by Digital Science of Macmillan Publishers. figshare offers a limited amount of free storage space for private use, and an unlimited amount of storage space for publicly shared materials. Currently, users may upload figures, media (videos, audios), posters, papers, theses, code (source code and binaries), presentations, datasets, and filesets. According to figshare datasets "usually provide raw data for analysis. This raw data often comes in spreadsheet form, but can be any collection of data, on which analysis can be performed." Typical file formats include CSV, XLS, XLSX and SAV. Filesets, on the other hand, "offer a solution to those wishing to group multiple files as a single citable object. These are often experiments or workflows." (figshare n.d.a)

Each item on figshare can be assigned to multiple sub-disciplines that are grouped in 13 main disciplines. As soon as a user makes an uploaded material publicly available, it gets allocated a DataCite DOI. figshare also keeps track of usage data, and displays selected statistics on the page of each item (figshare, n.d.b). In addition, figshare hosts the supplemental data for all PLOS journals (figshare, 2013).

Altmetric scores are spread over a variety of social media channels, e.g., Twitter, Mendeley, or Facebook, which often enough results in complicated and time-consuming approaches for data collection. PlumX and ImpactStory are among the most popular collectors of social media data, providing convenient, but fee-based access to altmetric scores. PlumX targets institutions (e.g., publishers, libraries, or universities) whereas ImpactStory works best for individual researchers. The aggregators differ in the number of social media channels and type of permanent identifiers (e.g., DOI, PubMedID) searched as well as the output format (e.g. json) of retrieved altmetric scores (Chamberlain, 2013). Inevitably, the aggregators' attributes will result in different numbers of documents as well as altmetric scores found (Chamberlain, 2013; Zahedi, Fenner, & Costas, 2014). Jobmann et al. (2014) showed that Plum Analytics had highest coverage and scores in Mendeley and Facebook, whereas ImpactStory recorded a higher coverage of Twitter.

Methodology

We used the figshare API to retrieve the basic metadata for all publicly available records up until (excluding) December 2, 2014. We retrieved the metadata for 1,092,808 items. The following fields were used in the analysis: defined_type, published_date, DOI. We then gathered extended metadata for all datasets and filesets with a unique DOI (n=266,961 items). From this dataset, we used the following fields for the analysis: categories, downloads, views[2]. Both datasets are openly available (see Kraker et al., 2015).

[2] We did not investigate shares, due to the unclear semantics of this term in figshare."shares" does not refer to actual shares on social media platforms; it is rather counted how often one of the sharing buttons is clicked on the page of the individual item.

Subsequently, the top 500 downloaded items and the top 500 viewed items were analysed with PlumX and ImpactStory via their DOIs. Their coverage on social media platforms and the altmetric scores were compared. The analyses in PlumX were performed at the end of January 2015; the ImpactStory download took place between December 15th, 2014 and January 27th, 2015.

Results

General Analysis of figshare

Tables 1 and 2 show the distribution of basic metadata on figshare. Table 1 reveals that most content in figshare is provided by PLOS (89.2%). The PLOS journal with most items is PLOS ONE with 829,243 items, representing ¾ of the materials archived by figshare (75.9%).

Table 1. DOI providers (n=1,092,808 items)

DOI providers	items
PLOS ONE	829,243 (75.9%)
figshare	117,572 (10.8%)
PLOS Genetics	36,775 (3.4%)
PLOS Pathogens	33,245 (3.0%)
PLOS Computational Biology	29,517 (2.7%)
PLOS Neglected Tropical Diseases	20,376 (1.9%)
PLOS Biology	17,141 (1.6%)
PLOS Medicine	8,798 (0.8%)
none	141 (0.0%)

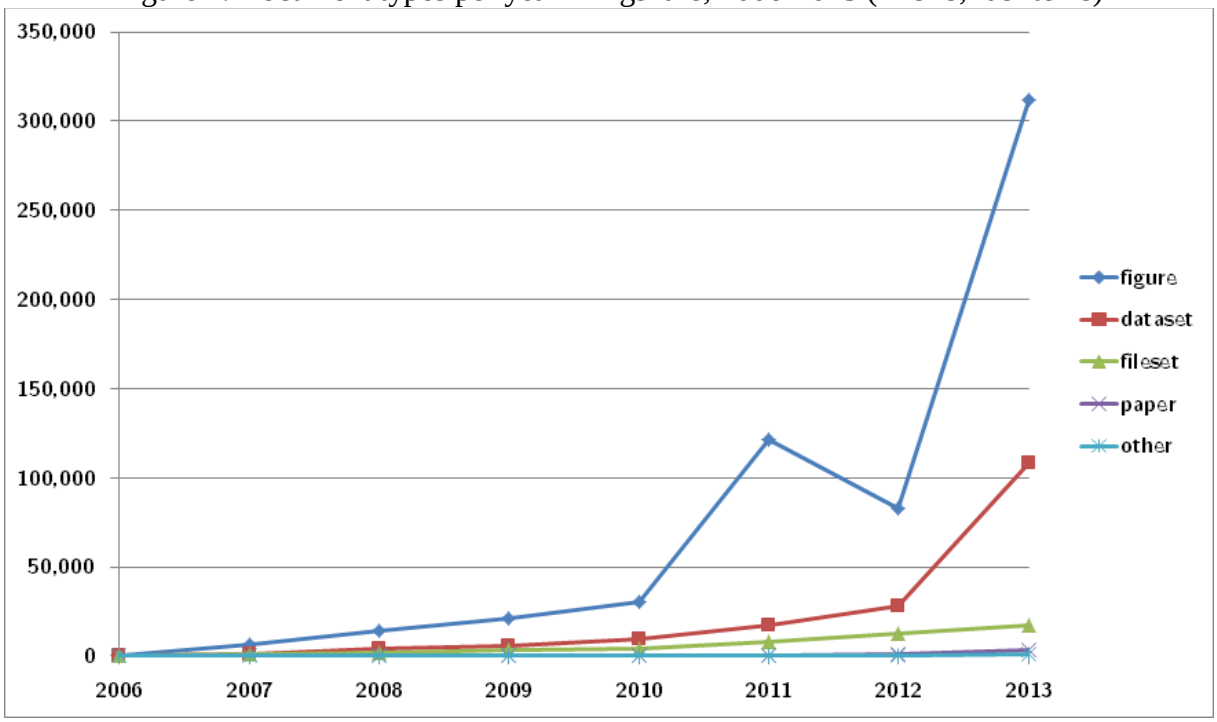
Table 2 presents the basic distribution of material type on figshare. Figure is the type with most items, followed by dataset and filesets. We found that PLOS has the largest share of materials in filesets (92.2%).

Table 2. Document types in figshare with a DOI (n=1,092,808 items)

type	#items	figshare	PLOS	none
figure	747,207	71,400 (9.6%)	675,799 (90.4%)	8
dataset	261,721	22,484 (8.6%)	239,177 (91.4%)	60
fileset	64,776	5,027 (7.8%)	59,748 (92.2%)	1
paper	14,369	14,351 (99.9%)	18 (0.1%)	0
presentation	1,434	1,434 (100%)	0	0
poster	1,429	1,429 (100%)	0	0
media	1,313	888 (67.6%)	353	72
code	366	366 (100%)	0	0
thesis	193	193 (100%)	0	0

Figure 1 shows that the number of research products is steadily increasing across all document types (except for “figure” where a significant drop in number can be noticed for 2012).

Figure 1. Document types per year in figshare; 2006-2013 (n=818,108 items)



Usage Analyses for datasets and filesets

Figure 2 shows the distribution of view and download frequencies among datasets and filesets. Both distributions are highly skewed, exhibiting that only a small fraction of items in figshare are highly used.

We also investigated whether views and downloads are correlated. Since the data is not normal distributed, we computed the Spearman correlation, which resulted in a correlation coefficient of 0.28. A more in-depth analysis of the distribution of the data revealed that out of 266,961 entries, 102,148 have 0 views and 0 downloads. We performed a spot-check investigation to analyse from which providers these entries come from. We found that many entries that have no views or downloads come directly from PLOS whereas entries that have a large number of views (>= 100 Views, 2 entries even have > 10,000 views) are posted directly on figshare. We also found that downloads and views follow a power-law distribution. Consequently, views and downloads follow the principle of preferential attachment which means that items that have many views/downloads will be more likely viewed/downloaded.

Table 3 shows the distribution of disciplines among filesets and datasets. 88.9% of all items have been assigned to Biological Sciences, which makes it the top discipline. Chemistry comes second and Earth and Environmental Sciences third. When leaving out items from PLOS, Biological Sciences is still the largest discipline, but Engineering and Social Science become the second and third largest discipline respectively.

Figure 2. Distribution of view and download frequencies among datasets and filesets in figshare on a logarithmic scale (n=266,961 items)

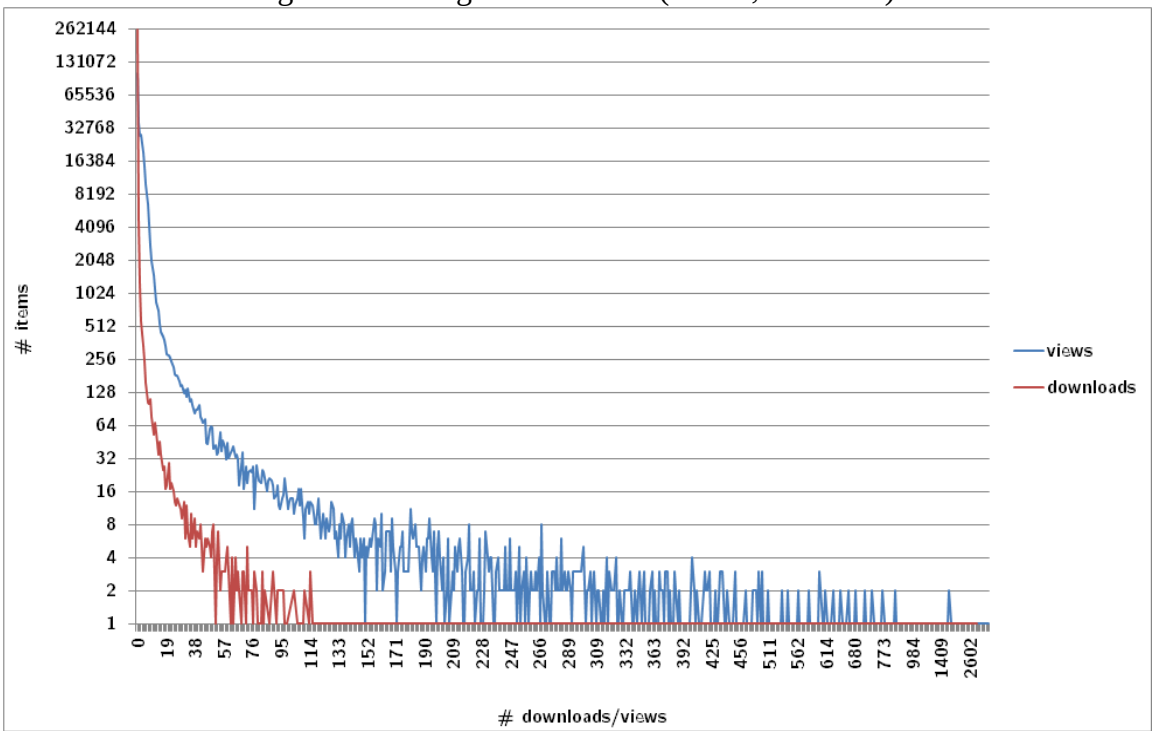


Table 3. Distribution of disciplines among filesets and datasets, multiple choices possible (n=266,961 items)

discipline	#items	figshare	PLOS	none
Biological Sciences	237,211	8,665	228,561	58
Chemistry	39,535	3,764	35,789	3
Earth and Environmental Sciences	23,260	2,840	20,417	4
Meta Science (e.g., science policy and survey results)	13,660	407	13,236	17
Mathematics	12,417	362	12,056	2
Information And Computing Sciences	11,130	1,761	9,374	1
Social Science	9,814	4,138	5,676	
Engineering	8,448	6,217	2,231	
Psychology	7,195	306	6,892	
Physics	5,800	521	5,288	1
Uncategorised	4,218	284	3,933	1
Humanities	1,665	1,665		
Astronomy, Astrophysics, Space Science	1,248	1,221	27	
Health Sciences	521	521		

Results of the altmetrics analysis

As mentioned above, we performed an altmetrics analysis in PlumX and ImpactStory of the top 500 downloaded and top 500 viewed datasets and filesets. 243 items appeared in both

samples; that means almost 50% of the most viewed items were also most downloaded. Thus, we analysed all unique items (i.e., DOIs) in both samples (n=757). We first report the results of the individual analyses and then compare the outcome of both aggregators with respect to coverage and scores.

Results of PlumX

Table 4. General results of the analysis in PlumX. DT=document type (n=757 items)

Type	Data	File Set	Other	All DTs
# items total	281	456	20	757
# items with captures	8	14	1	23
Captures Total	9	36	18	63
Captures Mean	0.03	0.08	0.90	0.08
Captures Maximum	2	12	18	18
# items with social media	214	294	16	524
Social media Total	4313	6100	448	10861
Social media Mean	15.35	13.38	22.40	14.35
Social media Maximum	635	388	115	635
#items with mentions	17	23	1	41
Mentions Total	95	89	1	185
Mentions Mean	0.34	0.20	0.05	0.24
Mentions Maximum	24	22	1	24
# items with usage/views	281	456	16	753
Usage - Views - Total	138717	236829	11987	387533
Views Mean	493.65	519.36	599.35	511.93
Views Maximum	4992	26985	5764	26985
# items with usage/downloads	242	445	16	703
Usage - Downloads - Total	7296	30292	1863	39451
Downloads Mean	25.96	66.43	93.15	52.11
Downloads Maximum	582	4534	1240	4534
# items with scores	281	456	16	753
Total Scores	150430	273346	14317	438093
Scores Mean	535.34	599.44	715.85	578.72
ScoresMaximum	5020	30306	7005	30306

Table 4 shows general results of the analysis in PlumX. The results exhibit a low number of scores in the categories “captures”, “mentions” and “social media”. In contrast to that, usage numbers were a lot higher. Interestingly, PlumX did not identify all items as “data” or “file sets” as was expected, but created further document types (the category “other” comprises of 3 articles, 1 code, 2 figures, 8 papers, 4 posters, and 1 presentation, accounting for 2.6% of the sample).

Tables 5, 6 and 7 show the origin of the scores in PlumX for captures and mentions, social media and usage. Table 5 indicates that almost all of the captures originate from Mendeley, whereas mentions are predominantly comments in Facebook[3].

Table 5. Captures and mentions in PlumX for each document type

	Captures		Mentions		
Document Type	Bookmarks :Delicious	Readers: Mendeley	Comments :Reddit	Comments :Facebook	Links Wikipedia
Data	1	8	6	84	5
File Set		36	1	88	
Other (Paper)		18		1	
Total	1	62	7	173	5
%	1.59%	98.41%	3.78%	93.51%	2.70%

Table 6 suggests that Twitter is the predominant provider of altmetric scores, followed by Google+ –besides the number of shares in figshare, as already reported above.

Table 6. Social Media in PlumX for each document type

	Social Media					
Document Type	Scores: Reddit	Shares: Figshare	Shares: Facebook	+1s: Google+	Tweets: Twitter	Likes: Facebook
Data	26	1214	224	448	2245	156
File Set	2	2122	349	692	2638	297
Other	0	82	17	48	293	8
Total	28	3418	590	1188	5176	461
%	0.26%	31.47%	5.43%	10.94%	47.66%	4.24%

Table 7 shows that almost all the usage data for the document type "data" are coming from figshare. For the document type "file sets", we also retrieved scores in EBSCO, PLOS and PubMed, but in very low proportion (less than 10% of the downloads, or 1% of the total usage volume). Please note that some subcategories (like PDF-Views or HTML-Views, see Table 7) could be assigned to both groups. In our analysis, they were considered as "downloads" rather than "views". Due to their low amount number, however, they should not distort the general results.

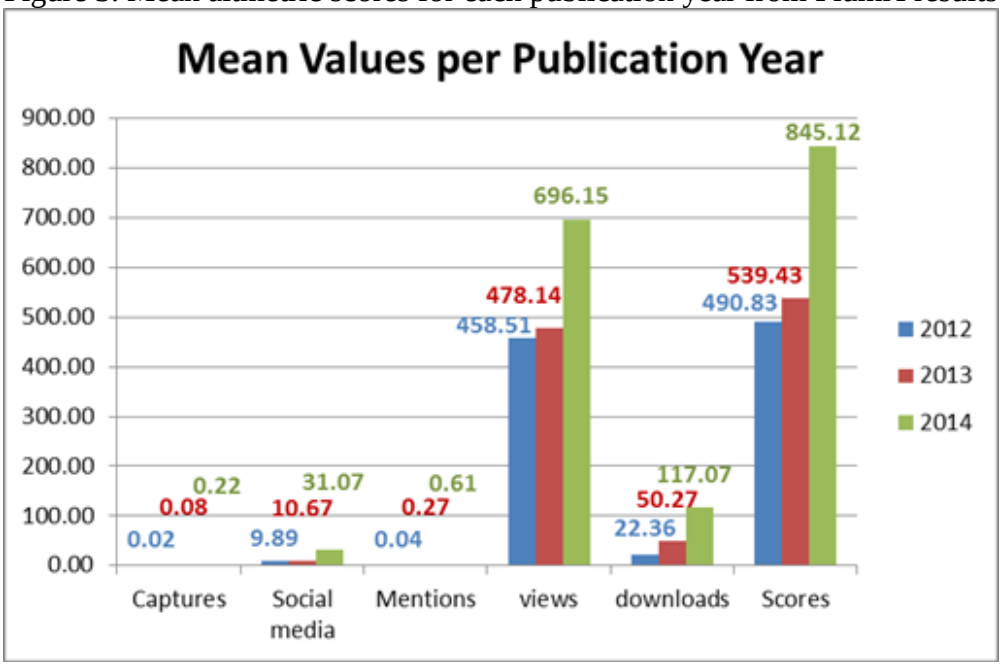
[3] Comments in Reddit and in Facebook are assigned to the category "mentions" in PlumX, although they could equally be assigned to "Social Media". In our comparison of PlumX and ImpactStory, comments, likes and shares in Facebook are aggregated to one group or type.

Table 7. Usage data in PlumX for each document type

	Usage								
	Views			Downloads					
Document Type	Views: Figshare	Abstract Views: EBSCO	Clicks: Bitly	PDF Views: PubMed Central	PDF Views: PLoS	PDF Views: EBSCO	HTML Views: PubMed Central	HTML Views : PLoS	Downloads : Figshare
Data	138245		472						7296
File Set	236421	33	375	16	760	13	67	3666	25770
Other	2381	0	247	0	0	0	0	0	206
Total	386372	33	1128	16	760	13	67	3666	34929
% Views/Downloads	99.70%	0.01%	0.29%	0.04%	1.93%	0.03%	0.17%	9.29%	88.54%
% Usage	90.49%	0.01%	0.26%	0.00%	0.18%	0.00%	0.02%	0.86%	8.18%

Finally, Figure 3 shows the mean values for each category (captures, mentions, social media and usage data) depending on the publication year of the document. The mean values of all groups have strongly increased since 2012 despite of the shorter analysis window.

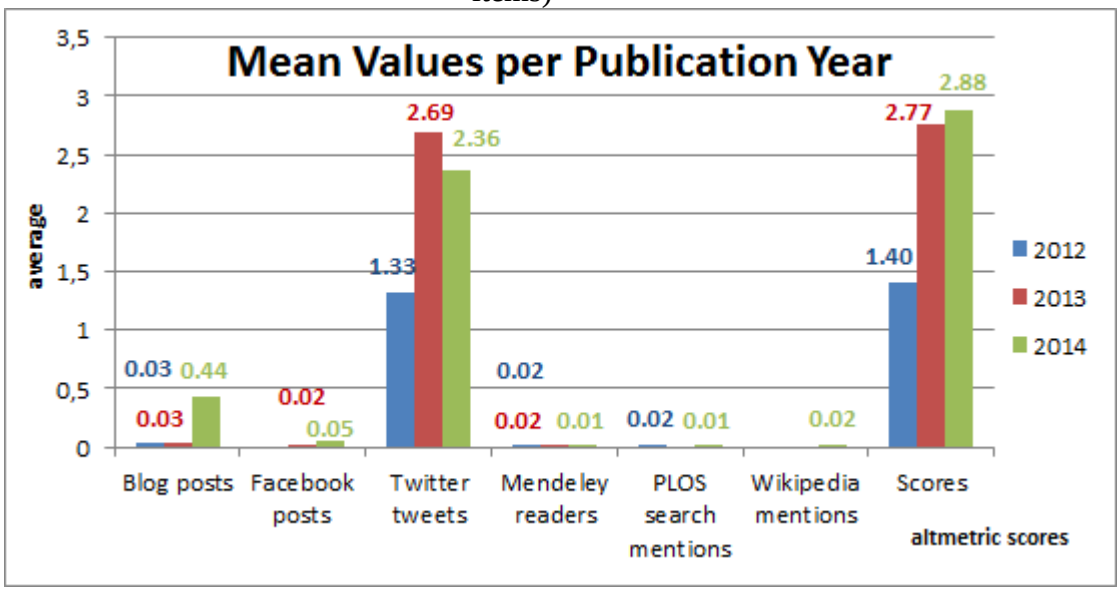
Figure 3. Mean altmetric scores for each publication year from PlumX results



Results of ImpactStory

For the 757 unique DOIs, ImpactStory reported altmetrics scores for 455 DOIs (60.1%). Figure 4 shows that items from 2014 attracted the most attention across social media services. The highest altmetrics scores per year are found for tweets followed by blog posts. The increasing number of blog posts is also crucial for the good reception of figshare data in 2014.

Figure 4. Mean altmetric scores for each publication year from ImpactStory results[4] (n=455 items)



Comparison of altmetric scores from ImpactStory and PlumX

Table 8. Results of the comparison of ImpactStory (n=455 items) and PlumX (n=757 items).

	ImpactStory results			PlumX results		
Type	data	file set	other (incl. article, code, figure, paper, poster, presentation, other)	data	file set	other (incl. article, code, figure, paper, poster, presentation, other)
# items	168	278	9	281	456	20
# of items with at least one Mendeley-reader	5	2	0	7	14	1
# Mendeley-readers total	6	2	0	8	36	18
# of items with at least one Wikipedia-mention	1	0	0	3	0	0
# Wikipedia-mentions total	2	0	0	5	0	0
# of items with at least one Tweet	44	64	3	176	254	15
# Tweets total	365	536	54	2245	2638	293
# of items with at least one Facebook-post	3	4	0	281	456	20
# Facebook-posts total (incl. likes, shares, comments)	3	6	0	464	734	26
Total scores	376	544	54	2722	3408	337
	ImpactStory results			PlumX results		

[4] Please note: scores for blogs, Facebook and Twitter are provided by altmetric.com for ImpactStory.

Table 8 shows the numbers of items per figshare-document type retrieved from ImpactStory and PlumX as well as the altmetric scores for the social media-platforms both aggregators share. All items (i.e., DOIs) that have been found via ImpactStory (n=455) were also found via PlumX (n=757). PlumX detects considerably more items in social media and also finds higher altmetric scores than ImpactStory. The aggregators, however, differ in the number of social media platforms analysed. For our set of items, ImpactStory uncovers items searched in PLOS and mentioned on blogs. PlumX, on the other hand, reports counts from many other tools not included in ImpactStory (e.g. Reddit; see Tables 5, 6 and 7).

Discussion and Conclusions

In our study, we found that almost 90% of all entries in figshare are coming from PLOS. figshare therefore has three basic functions: it acts (1) as a personal repository for yet unpublished materials, (2) as a platform for newly published research materials, and (3) as an archive for PLOS. These different functions are also highlighted by the fact that unviewed and non-downloaded items tend to originate from PLOS. These items are mainly used on the PLOS site, and not on figshare.

It is important to consider the different functions when interpreting the results of a figshare analysis. When analysing the discipline distributions of datasets and filesets, one could easily assume that most users who share their data are from the Natural Sciences (88.9% of all items are assigned to Biological Sciences, Chemistry comes second and Earth Sciences third). More in-depth analysis, however, reveals that the majority of Natural Sciences content is coming from PLOS, and that there seems to be a larger user group sharing datasets coming from Engineering and Social Science. Another unexpected result was that the most shared type of research material is not data, but rather images.

In the altmetrics analysis, we found that Twitter was the social media service where research data gained most attention; generally, research data published in 2014 were most popular across social media services. PlumX detects considerably more items in social media and also finds higher altmetric scores than ImpactStory.

Compared to our previous analysis performed for research data with two or more citations in Data Citation Index (DCI), the following conclusions can be drawn:

- Most research data remain not only uncited but also unviewed/not downloaded.
- Corresponding altmetrics scores for most cited, downloaded and viewed research data are very low, but overall the numbers have been increasing within the last 3 years.
- The results of the comparison of PlumX and ImpactStory are very similar to those obtained in our previous study. In general, comparison of altmetrics tools is difficult due to differences in assignments to categories, which result in different counts. Furthermore, it is hard to judge correctness and completeness of the counts.

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