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Do altmetrics promote Open Access? An exploratory analysis on altmetric differences between types of access in the field of Physics[1]

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Introduction

The promotion of Open Science needs new metrics that encourage openness in scientific practices, and can help institutions to monitor it (Wilsdon et al., 2017). These metrics should abide the principles of RRI, in that they should not exacerbate problems of research quality, integrity and reproducibility (Sarewitz, 2016). Furthermore, they should cover the complete research cycle from data collection to public dissemination (European Commission, 2016). For this purpose, in 2017, the European Commission (EC) created an Expert Group with the task of informing the commission on the possibility of including altmetric indicators as potential metrics that could foster and monitor open science advancements (Wilsdon et al., 2017). Since their inception in 2010, altmetrics have raised great interest. Originally conceived as a myriad of metrics, "great for measuring impact in this diverse scholarly ecosystem" (Priem, Taraborelli, Groth, & Neylon, 2010), it was soon suggested that they could be capturing 'broader forms of impact' of research (Bornmann, 2014).

These propositions have been questioned in several occasions (Robinson-Garcia, Costas, Isett, Melkers, & Hicks, 2017; Sugimoto, Work, Larivière, & Haustein, 2017). However, regardless of the societal impact debate, altmetric indicators result from ongoing changes in the scholarly communication and production system, and as such, it is worth considering their capacity to reflect these changes. In fact, more nuanced methods are being suggested and a deeper understanding on what altmetrics signal is being gained (Costas, van Honk, Zahedi, & Calero-Medina, 2016; Haustein, Bowman, & Costas, 2016; Robinson-Garcia, van Leeuwen, & Rafols, 2018; Vainio & Holmberg, 2017).

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According to Moed (2016), three drivers have motivated the emergence of altmetrics: 1) increasing awareness on the multidimensionality of research performance, 2) changes in the scientific communication system due to computational advancements, and 3) the emergence of the Open Science movement. The latter explains partly the EC's interest on incorporating altmetrics as Open Science metrics. Still the Expert Group's report was inconclusive in its recommendations (Wilsdon et al., 2017). While it acknowledged the potential of altmetrics as well as its many limitations, it failed to show how these metrics can help to foster Open Science as conceived by the EC. The current paper analyses differences in altmetric scores between Green OA publications, Gold OA publications and non OA publications. The goal of the paper is to empirically study whether altmetric indicators reinforce Open Access practices regardless of the type of OA (green or gold). Here we report a preliminary analysis based on two Physics journals.

Data and methods

We selected two journals from the field of Physics: Physical Review B (PRB) and Physical Review X (PRX). PBR is a historical journal in the field of condensed matter physics. It is a non-OA journal, although it includes an APC option for those interested. PRX was launched in 2011 as full open journal, covering all areas of physics. Since late 2017, Web of Science includes information on OA documents and distinctions between gold and green OA (Clarivate Analytics, 2017). This is due to an agreement made with ImpactStory to incorporate the Unpaywall database, which tracks OA publications (Piwowar et al., 2017). While this accounts to a large share of OA documents, it does ignore other freely available documents such as those known as bronze OA (that is, free-to-read but without an explicit OA license), which accounts to almost 25% of all freely available documents worldwide (Martín-Martín, Costas, van Leeuwen, & López-Cózar, 2018).

Table 1. Distribution of documents by type of access and coverage in Altmetric.com

	Total	**Altmetric.com**	
Gold	1,326	1,164	87.8%
Green	4,464	2,001	44.8%
Non-OA	34,254	11,173	32.6%
Total	**40,044**	**14,338**	**35.8%**

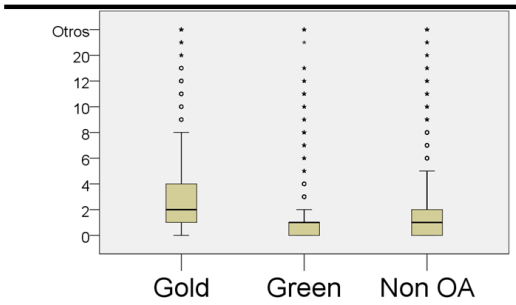
We retrieved all documents published by these two journals since 2011. Our total sample account to a total of 40,044 documents. We retrieved altmetric indicators associated to these publications using the Altmetric.com database (Robinson-García, Torres-Salinas, Zahedi, & Costas, 2014). This was done on March 2018. This database included a total of 14,338 documents from our set. Table 1 shows coverage rates of Altmetric.com.

Based on those documents included in Altmetric.com, we descriptively analyzed the following altmetric indicators to explore if there were significant differences on the number of mentions received by each group of documents: Twitter mentions, news media and blog mentions and the Altmetric Attention Score (AAS). Although we acknowledge the many limitations of this composite index (Gumpenberger, Glänzel, & Gorraiz, 2016), we included it as a means to explore overall mentions to papers.

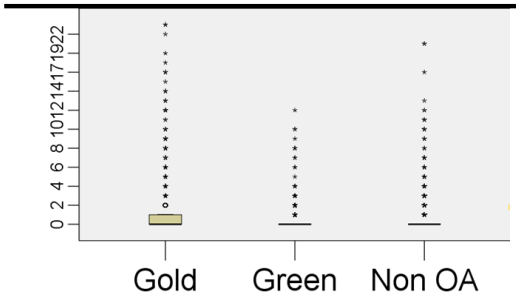
Results

Altmetric scores follow a skewed distribution, as is common in the field of bibliometrics. In the case of altmetrics, this skeweness is even more evident due to the large number of zeros in the distribution. Figure 1 shows descriptive indicators for AAS, news and blog mentions and Twitter mentions to our set of documents disaggregated by type of access. As observed, in the three cases, gold OA documents tend to receive a larger number of mentions than green and non-OA documents do. In fact, differences seem to be evident between gold OA and the other two groups, but not between green OA and non-OA documents.

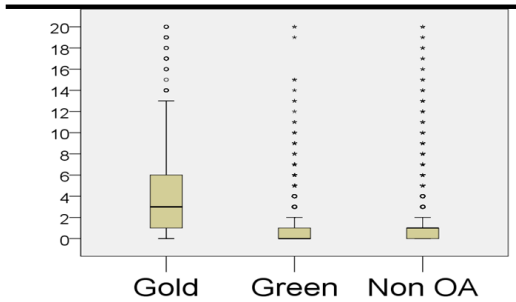
Figure 1. Distribution of AAAS, news mentions and Twitter mentions by document by type of access



AAS	GOLD	GREEN	NON OA
Mean	12.11	2.16	2.29
Median	2	1	1
Std. Dev.	35.00	5.66	6.16
Max.	648	95	312



News and blogs mentions	GOLD	GREEN	NON OA
Mean	1.13	0.23	0.22
Median	0	0	0
Std. Dev.	3.77	0.84	0.90
Max.	57	12	40

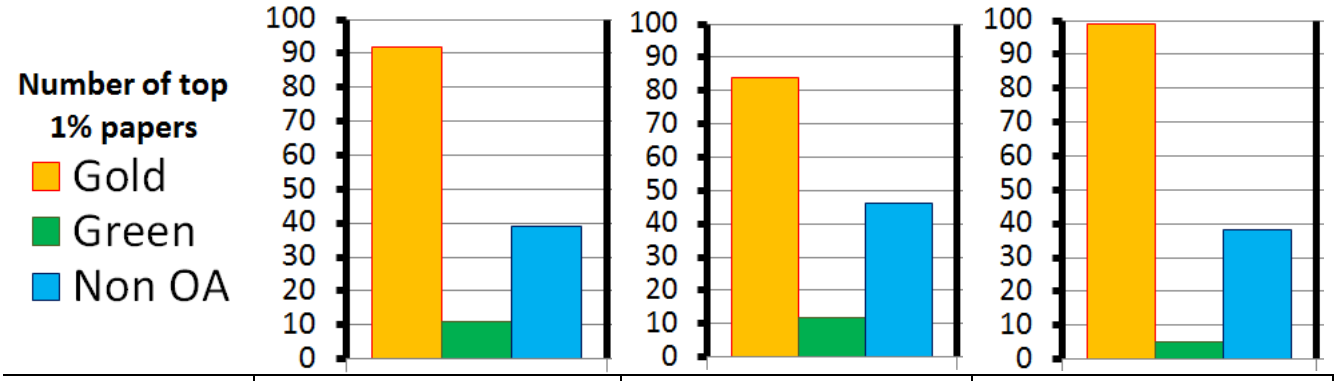


Twitter	GOLD	GREEN	NON OA
Mean	6.95	1.07	1.27
Median	3	0	1
Std. Dev.	16.45	3.00	2.96
Max.	281	22	140

These differences are even more evident when focusing on the top 1% of papers with the highest share of altmetric mentions. Although gold OA documents represent 8% of the total number of documents from the two journals under analysis indexed in Altmetric.com; within the top 1% highly altmetric papers, 65% are gold OA according to their AAS, 59% are based on news and blog mentions, and 70% on number of tweets (see figure 2). While the smallest

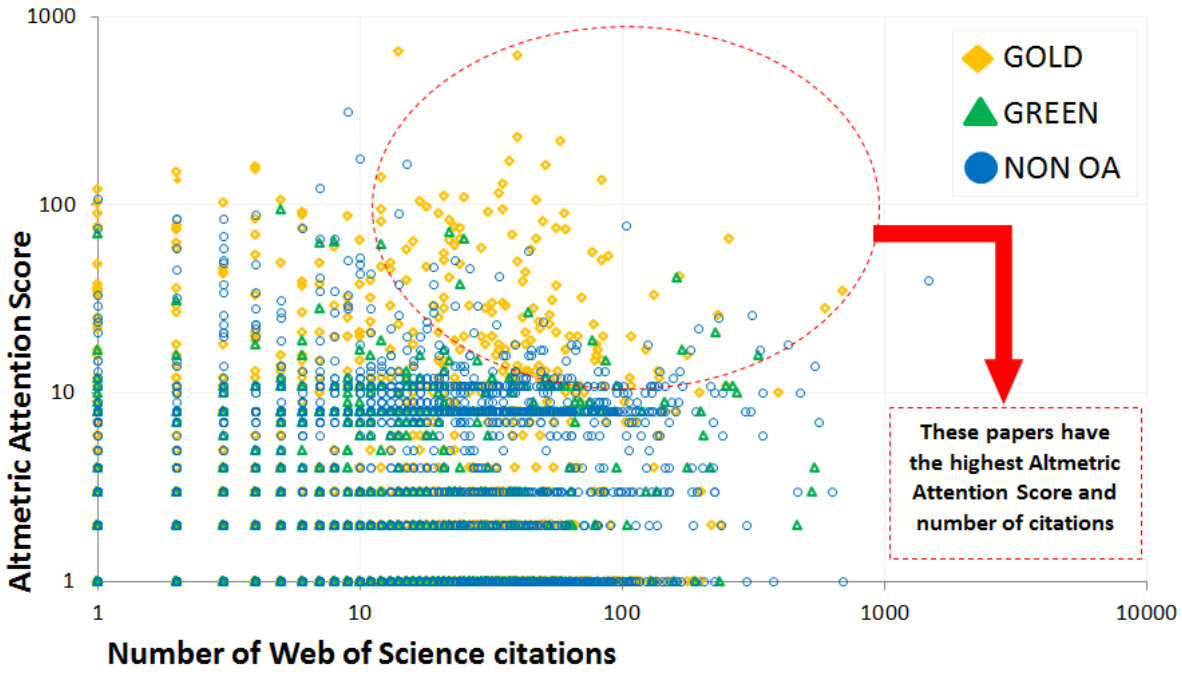
group is the green OA one, differences are even more significant for non-OA, considering that 77% of the papers in Altmetric.com belonged to this group.

Figure 2. Number of top 1% papers with the highest AAS by type of access



	Altmetric Score		News and blogs mentios		Twitter	
	Nr Papers	% Papers	Nr Papers	% Papers	Nr Papers	% Papers
Gold	92	7,90%	84	7,22%	99	8,51%
Green	11	0,55%	12	0,60%	5	0,25%
Non OA	39	0,35%	46	0,41%	38	0,34%

Figure 3. Scatterplot of papers based on the AAS (y-axis) and number of citations (x-axis) and type of access.



In figure 3 we try to put into perspective these differences by type of access to see if these are derived from the citation impact generated by the papers belonging to these groups. We plot the number of citations by document against its AAS. Still, there is no clear relation between citations and the AAS, as has been observed in other altmetric studies (Costas, Zahedi, &

Wouters, 2015; Thelwall, Haustein, Larivière, & Sugimoto, 2013). Again, we observe that gold OA documents receive higher AAS scores than the other to groups of documents.

Discussion and concluding remarks

This paper analyses altmetric differences by type of access to documents. We distinguish between three types of access to the document: green OA, gold OA and non-OA. Here we report a preliminary analysis based on two journals from Physics. We use this descriptive analysis as a proof-of-concept before expanding our study to other fields and introducing more advanced statistical methods. Our results show that gold OA documents are best covered in Altmetric.com and receive higher mentions than documents with other types of access. This is especially troublesome in the case of green OA, as it reflects that altmetric indicators do promote a very specific type of access closely linked with the publishing industry (Torres-Salinas, Robinson-Garcia, & Moed, 2018). Furthermore, it has negative implications for the effectiveness of institutional policies promoting green OA through the creation of repositories and OA infrastructure.

This paper does not intend to delve into the reasons behind these differences, but to be a first step. Further research will require the implementation of a large-scale study in which other types of access and documents (i.e., not published pre-prints) could be included, as well as other scientific fields covered.

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