Global country-level patterns of Mendeley readership performance compared to citation performance: does Mendeley provide a different picture on the impact of scientific publications across countries?

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Abstract

As bibliographic reference managers like Mendeley made their data openly available, it became possible to track where in the world research was being saved from. This data offered the opportunity to better understand how research circulates at a global scale with measures that go beyond citations. This paper explores this circulation by studying fluctuations in rankings between countries when they are based on mean normalized citation scores (MNCS) or on mean normalized Mendeley readership scores (MNRS). Results show that both indicators are moderately correlated at the country level, but that countries from the Global South (namely African and South American countries) perform better when ranked by Mendeley readership than by citations. In addition, publications from South America and Africa tend to have a lower citation impact compared to those from Europe and North America, even when compared with publications that have the same number of readers. These results suggest that the indicator chosen (i.e., citations or Mendeley readers) creates different (dis)advantages among scholarly actors (e.g. countries, research organizations, journals, etc.). It also hints at the need to establish evaluation frameworks that consider that different metrics play different roles across institutional and geographical boundaries. We conclude by proposing further ways of exploring these metrics.

Introduction

Mendeley readership have been suggested as one of the most important sources of social media metrics from several perspectives. Firstly, it is the altmetric source with the largest coverage of scientific publications (Thelwall & Sud, 2016) and with the highest correlation with citations (Costas, Zahedi, & Wouters, 2015a). Secondly, Mendeley readership and citations exhibit similar pattern in their distributions across different fields of science (Costas, Haustein, Zahedi, & Larivière, 2016). Thirdly, Mendeley readership have a stronger conceptual proximity with citation indicators, therefore arguably having a more scholarly focus than any other social media metrics (Wouters, Zahedi, & Costas, 2018). These characteristics suggests the potential of Mendeley readership being incorporated in research evaluation processes (Zahedi, 2018). As such, normalization of the number of readership by discipline (Haunschild & Bornmann, 2016) and estimating *exchange rates* for quantifying the differences between citations and Mendeley readership across fields (Costas, Perianes-Rodríguez, & Ruiz-Castillo, 2017) have been already suggested in the literature. Moreover, it is known that geographical variations in terms of coverage and density of social media metrics across different countries exists (Alperín, 2015) which can lead to biases in social media metrics at the country level (Zahedi, 2016). It has been observed that Twitter users prefer to tweet publications from other countries than their own (Zahedi & Costas, 2017) while Mendeley users seem to prefer to save (read) publications from their own country than from any other country (Thelwall & Maflahi, 2015). However, little is known about how Mendeley readership varies across countries, and how these country-level differences in readership patterns relate to citations. As such, this study aims to fill this knowledge gap by addressing the following research question: *are there differences across countries in their*

ranking positions depending on whether they are based on mean normalized citation scores (MNCS) or on mean normalized Mendeley readership scores (MNRS)?

Methodology

For this study, a total of 10,307,814 scientific publications (article and review document types) covered in the Web of Science during the period 2010 and 2017 and having a DOI were selected. Citation and Mendeley readership indicators were calculated using the most recent data available in July 2018. Country data was obtained from the author affiliation field and, as an initial exploratory approach, full counting was used. Two basic indicators based on Mendeley readership and citations (including self-citations) and field-normalized indicators have been calculated at the publication level: *ncs* (normalized citation score) and *nrs* (normalized readership score). These values have been averaged for each country, thus obtaining a *Mean Normalized Citation Score* (MNCS) and a *Mean Normalized Readership Score* (MNRS) per country. The Web of Science Subject Category classification has been used as the underlying disciplinary classification for field-normalization. Essentially, the same normalization methodology as suggested by Waltman & Van Eck. (2013) for citations and Bornmann & Haunschild (2016) for readership have been applied here. For some analyses the *Mean Citation Score* (MCS) and the *Mean Readership Score* (MRS) without field normalization have also been considered. Finally, a total of 82 countries with more than 5,000 publications in the period of analysis have been selected for further analysis. For each country, both MNCS and MNRS indicators have been first ranked by the indicator and second by number of publications in case of ties. Countries have also been classified across 6 world regions (Africa, Asia, Europe, North America, South America, and Oceania). For comparing rankings and indicators, descriptive statistical analyses have been performed using IBM SPSS version 23.

Results

The MNCS and MNRS values at the country level were compared across world regions. The box plot distributions for each country group shows that the MNRS distributions of countries from Africa and South America are sensibly higher than their MNCS (Figure 1).
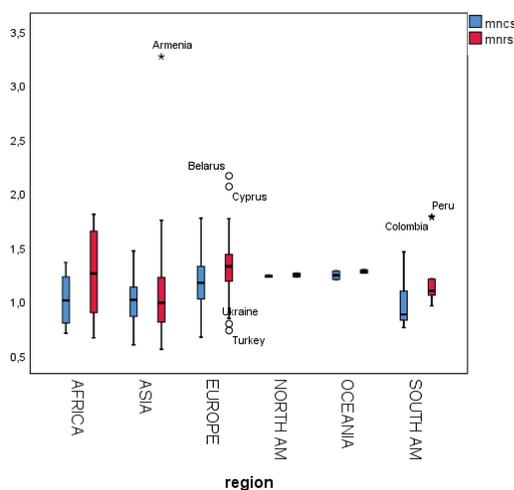

Figure 1. Distribution of countries by MNCS and MNRS indicators and by world regions

Two scatter plots showing the correlations between MNRS and MNCS and between MRS and MCS (i.e. the indicators without field normalization) reveal the relationship between readership and citations (Figure 2). Correlations of rankings are moderate in both cases (R^2 linear values of 0.395 for MNRS/MNCS and of 0.560 for MRS/MCS). This reinforces the idea that readership and citations are related, but are not totally equivalent indicators (Haustein, Bowman, & Costas, 2016).
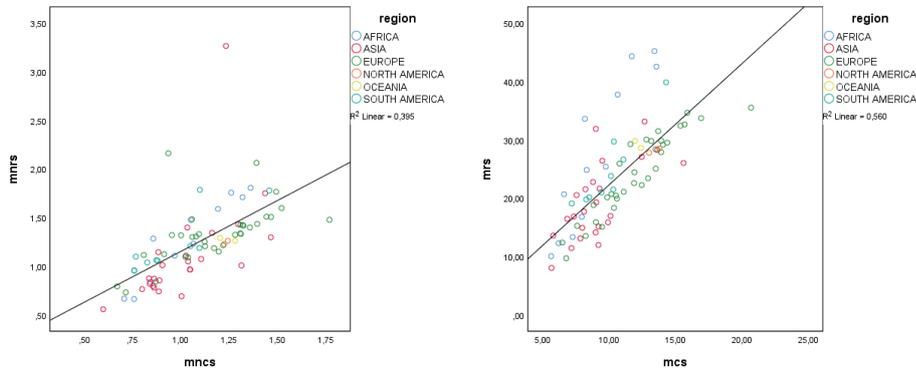

Figure 2. Scatter plot correlations between MNCS and MNRS (left graph); and MCS and MRS (right graph) for countries (colored by world regions)

As suggested by the distribution plots (Figure 1), a substantial presence of African countries lie above the regression line, suggesting that these countries have a higher position in the distribution by MNRS in relation to their position by MNCS. In order to explore this point further, the difference in rank position was calculated to measure how much countries would go up (or down) when comparing their MNCS to their MNRS. Plotting the distribution of these differences reveals very clearly how African and South American countries increase the most (more readership than citations), while the positions of European, North American (i.e. USA and Canada) and Oceania (i.e. New Zealand and Australia) countries stagnate or lose position when ranked by readership (Figure 3).
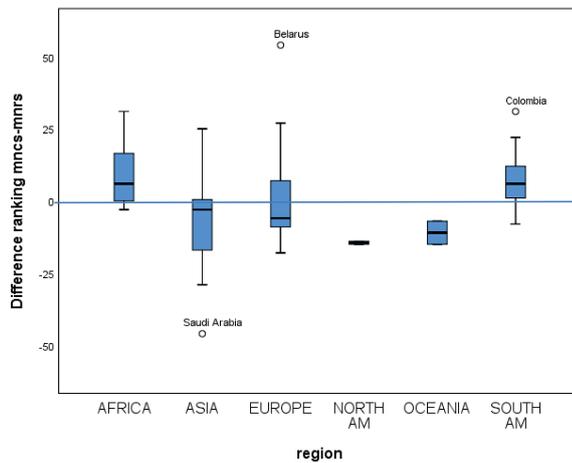
Results from the above analyses highlight that countries from Africa and South America would be seen as performing better, on average, if Mendeley readership was considered in place of citations. In order to further test this idea, an *analysis of equals* is developed. For this analysis, all publications with a *nrs* value between 0.96 and 1.04 were chosen (essentially publications that are around the reference value of 1 in their fields by readership). Given this group of publications with mean readership, MNCS values were calculated for each country and averaged by world region (Figure 4).
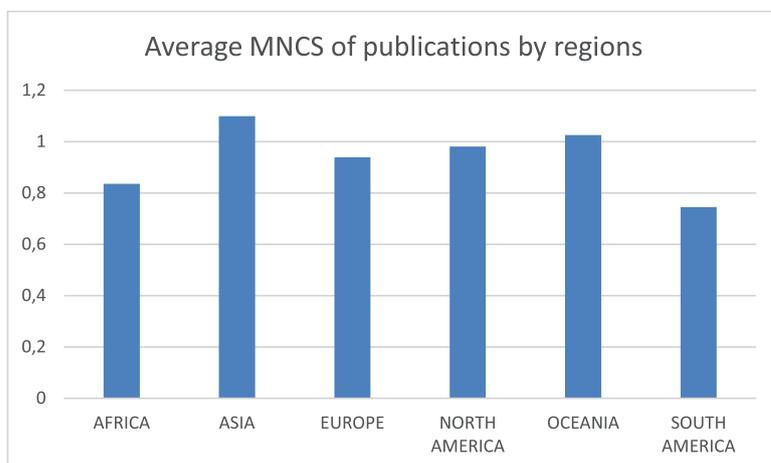

Figure 4. Analysis of publications with *nrs* values between 0.96 and 1.04 (327,355 publications) by world regions and MNCS indicator

Figure 4 shows a quite clear pattern in which publications from African and South American countries exhibit an overall lower average MNCS value. This means that for publications of equal readership impact, African and South American countries publications receive less citations.

Discussion and further research

The results presented here open new discussion of the possibilities offered by social media metrics, particularly those derived from Mendeley readership. Firstly, the metrics calculated here corroborate previous findings about the moderate correlation between citations and Mendeley readership (Sugimoto et al., 2017; Zahedi, 2018) and extend the notion that this moderate correlation is also observable at the level of countries. Secondly, the analysis presented here shows that, in spite of these moderate correlations, there are differences in how countries rank in relation to one another depending on which of the two measures are used. Interestingly, the countries from Africa and South America move from lower ranking positions when ranked by MNCS to higher ones when ranked by MNRS. Correspondingly, countries from Europe and North America move down in the rankings. This is particularly important as it sheds light on the disadvantage that countries from the Global South find themselves in when citations are given importance over readership and the circulation of the research.

The results open the relevant question of *what are the possible explanatory factors of the Mendeley readership advantage for publications from the Global South?* More specifically, it

begs the question: *why is there variation in the citation performance across countries for publications with similar levels of readership?* These effects may be the result of the Matthew effect (Merton, 1968), in which authors, read publications indiscriminately, but at the time of choosing what to cite they choose those coming from the most reputed institutions and countries, thus reinforcing the citation cumulative advantage of already scientifically advanced countries. Alternatively, it may be that this is the combined effect of the national readership affinity of Mendeley users (Thelwall & Maflahi, 2015) as well as the national affinity of citations (Sugimoto, Gong, & Larivière, 2018). That is, authors from the Global South read (and potentially would cite) more the publications of their own countries, but may be facing stronger difficulties in publishing their work in Web of Science-index journals (or just international journals). As a result, the publications they are reading from their own countries would end up having fewer citations, thereby creating a disadvantage for the publications of their own countries. Additional potential explanations may be related to the different uptake of Mendeley across countries. For example, although in this paper we have accounted for field-differences, different thematic profiles may be at play (e.g. countries with greater uptake among fields with stronger focus on social sciences, which are the fields with traditionally higher readership scores; Costas, Zahedi, & Wouters, 2015b). Or, different national preferences on how Mendeley is used (e.g. users in some countries may use Mendeley more for reading or self-education in contrast to others where it is used to curate a bibliography for citing). These are all aspects that should be explored in future research, together with the incorporation of other more technical aspects, such as the exclusion of self-citations and self-readership and the fractional counting of country authorship. Our future research will focus on corroborating the results presented in this study by tackling these issues as well as using larger datasets and expanding the set of indicators.

Even in this preliminary form, the results presented suggest that more exploration is needed about to understand *what is the potential role of Mendeley readership for research evaluation?* As suggested in this study, there may be different (dis)advantages among scholarly actors (e.g. countries, research organizations, journals, etc.) depending on the indicator chosen. It is therefore important to open a debate about how to combine these different metrics (and the perspectives they bring) into the research evaluation. This may once again raise the idea of the potential need of sort of "exchange rates" (Costas, Perianes-Rodríguez, & Ruiz-Castillo, 2017). More pragmatically, it raises the need of establishing evaluation frameworks in which both citation and readership metrics can inform different forms of impact and reception among different communities and geographical boundaries.

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