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Do alternative metrics correlate with societal orientation of scientific work?: a mixed quantitative-qualitative study

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Introduction

Impact assessment of scientific publications is dominated by quantitative impact measures. In particular, citation counts and more advanced citation-based measures (e.g. H-index, Journal Impact Factor) are routinely used in contemporary research evaluation due to their ease of use, widespread availability, and potential for comparison across units. Lately, alternative metrics or ‘altmetrics’ have been proposed as additions to the metrics arsenal. As first coined by Priem et al. (2010), alternative metrics refer to the article-level “use of scholarly impact measures based on activity in online tools and environments” (Priem et al., 2012, p.1). Metrics include ‘mentions’ on social media that link to the original publication as well as stand-alone ‘posts’ in e.g. online news articles and blogs.

The emergence of alternative metrics coincides with increasing demands from administrators and funders to better align academic work with the needs and preferences of economy and society. Although such pressures are far from new, no accepted framework to systematically assess societal relevance, orientation and impact has emerged as of yet. It has been proposed that alternative metrics data could function as a potential source for measuring societal impact and broader impact ‘beyond science’ (Bornmann, 2014). Several authors have for instance commented on the potential for alternative metrics to measure engagement among a more heterogeneous set of audiences as well as focused on different impact domains such as public policy, technical innovation, clinical practice and education (e.g. Bornmann 2014; Costas et al. 2013, Haustein et al. 2013).

Despite these promises, we know however surprisingly little about what value alternative metric scores actually ascribe to research publications. Impact scores provide a proxy for the level of engagement with a publication as demonstrated by a particular audience. However, whether alternative metrics indeed capture usage of research among non-scientific audiences is disputed. On the one hand authors have argued that “social media has [...] opened a new channel for informal discussions among researchers, rather than a bridge between the research community and society at large” (Sugimoto et al. 2017, p. 2052) and that “altmetric measures are problematic as indicators (what do they indicate?) – given that the meaning of the measures is unknown, unclear or ambiguous at best” (Robinson-Garcia et al. 2018, p. 6). On

the other hand, empirical studies suggest that the type of engagement that is represented by alternative metrics scores is indeed different from citation impact measures as evidenced by the observation that correlations between citation counts and altmetric indicators are present but only weakly positive (Costas, Zahedi, & Wouters, 2015).

To provide further insight in the potential for alternative metrics data to be used as potential indicator of societal impact we examined whether there are any meaningful associations between alternative metrics scores and the societal orientation of research publications as perceived by scientific authors of those publications. Building on dominant understandings of societal relevance and impact in the research evaluation community, we approach our aim building on insights from process-oriented and interactional frameworks (Spaapen and van Drooge 2011; Joly et al. 2015; Robinson-Garcia et al. 2018) and by interviewing scientists on their perception and valuation of the research process including their productive interactions with academic and non-academic stakeholders during the process.

Research design

This is a mixed quantitative-qualitative retrospective cohort study of a sample of research publications written by academic researchers from Utrecht University, the Netherlands. Utrecht University is a large research-led university in the Netherlands that is home to a broad range of scientific disciplines carrying out fundamental and applied research. We used the university's staff database to create a sample of academic researchers with a PhD degree employed at one of four departments in four different faculties of the university: 1) Department of Physics, Faculty of Science 2) Department of Innovation, Environmental and Energy Sciences, Faculty of Geosciences 3) Department of Psychology, Faculty of Social Sciences, 4) University Medical Centre, Faculty of Medicine. The departments were chosen in such a way that they were heterogeneous in terms of scientific orientation and publication and citation culture and sufficiently large in size to ensure an adequate response.

For each researcher in our sample we selected a publication that was 1) written in English 2) published in the period 2012-2014, 3) available in Web of Science and 4) having an Altmetric Attention Score as determined through the API at altmetric.com. To ensure that potential respondents had sufficient knowledge about the publication we limited ourselves to publications on which the researcher was corresponding author or if no such publication existed a publication with a maximum of four authors. In case no publication was found potential respondents were excluded from the study. The selection resulted in a sample of 360 potential respondents and publications.

All respondents were invited to participate in the study through an e-mail invitation (and two reminders) explaining alternative impact measures of scientific work, the purpose of the study at hand, the specific article that would be the subject of the interview (15 minutes) and main interview topics (see below). In case the respondent agreed with participation, the interview was conducted face-to-face (with the exception of 4 telephone interviews) in the preferred language of the respondent (Dutch or English). Before each interview the respondent was asked for consent to audiotape the interview and for anonymous use of the material in a report and publication.

Interviews were structured based on a process framework that facilitated the respondent in providing a description of the complete research process from initial research idea, formation of team and research conduct into dissemination. Open questions were asked about four dimensions of the research process: 1) the motivation to conduct the study 2) constitution of

the research team 3) actual and envisaged linkages with target audiences, 4) valuation of the study process and findings. Additionally questions were asked about the main dissemination channels used by the authors and the research team. Three trial interviews were conducted resulting in feedback about flow, question relevance and missing or underexposed topics. These were not included in the sample.

All interviews were conducted by one author (BK) and transcribed non-verbatim. In a first round of coding descriptions by respondents of the four dimensions of the research process were clustered in common themes that signalled aspects of scientific or societal orientation. Subsequently a scoring system was developed to assess mentions of societal orientation on the four dimensions with scores for each dimension ranging from 0 to 2. All interviews were independently scored by two researchers (BK, JH) and in case of disagreement consensus was sought.

For the collection of impact indicators we relied on Web of Science for citation counts and Almetric LLP for alternative metric scores. Almetric LLP provides disaggregated data from a variety of sources, such as Twitter mentions, Mendeley saves, and an aggregated Almetric Attention score which is a weighted count of the attention received on the different altmetrics sources the company tracks (Almetric Support, 2017). All metrics data were extracted on August 16, 2017.

To establish associations between the societal orientation of the research publication as scored by the authors and the scores on indicators, we computed Spearman's rank-order correlations with two-tailed significance testing. Correlations were examined for the aggregated societal orientation score (maximum score of 8) and the four dimensions separately (maximum score of 2). Societal orientation scores were correlated with total citation count and weighted Altmetrics Attention Score in the primary analysis and unweighted Almetric Score, number of Twitter mentions and number of Mendeley saves in a secondary analysis. We also qualitatively and inductively searched for mechanisms that could explain why articles with mainly a scientific orientation had high scores on altmetric indicators and vice versa why articles with a clear societal orientation had low scores on altmetric indicators.

Preliminary results and discussion

Of 360 potential respondents, 147 agreed to an interview resulting in a response rate of 41%. In 114 cases (78%) the corresponding author on the publication was interviewed and in 133 (90%) cases the interviewee was either the first-author or last-author on the publication. An equal proportion of professors, associate professors, assistant professors and postdoctoral researchers participated in the study. Response rates however differed between departments with higher response rates for the department of the Faculty of Sciences and Geosciences, compared to Social Sciences and Medicine.

The median societal orientation score for all four dimensions combined was 2 [interquartile range 0-3] with scores ranging between 0 and 8. Of all publications, 40 (27%) had a societal orientation score of 0, whereas scores above 5 were relative rare (11 cases). Table 2 shows correlations between the societal orientation score and impact metrics. We did not find an association between the weighted Almetric Attention Score and the aggregated societal orientation. A weak positive and significant association was found for the dimension audience with a correlation coefficient of 0.179. There were neither significant associations between societal orientation scores and citation counts nor between societal orientation scores and unweighted altmetric scores, twitter mentions and Mendeley saves (not shown).

From the interview data several explanations emerged for the lack of correlation between societal orientation score and alternative metric indicators. Publications that scored high on the societal orientation score but had a low altmetric score were often applied contract research projects with a clearly defined target audience and ‘productive interactions’ with specific user groups during the research process. Publications that scored low on the societal orientation score but did have a high altmetric score often profited from press releases by (high-impact) journals or were picked-up by media outlets, e.g. because the articles were available open-access.

These initial results suggest that alternative metric scores do not necessarily provide an adequate reflection of the societal orientation of a scientific publication and the underlying research process. Given that societal orientation is a necessary (but not a sufficient condition) for generating societal impact this challenges the assumption that altmetric indicators can be used as an indicator for societal impact.

Table 1: Assessment framework to score the societal orientation of publications

	Score = 0	Score = 1	Score = 2
Motivation	Scientific understanding, advancement or career	Indirect: contribute knowledge in the context of mission-oriented program	Direct: specific question from practitioner or industry
Team	Only academic scientists	Involvement of co-authors research institutes or practitioners with a university affiliation	Involvement of co-authors without a university or research institute affiliation
Target audience	Scientists only or primarily	Practitioners or industry as (one of the core) audiences but use is unspecified	Practitioners or industry as (one of the) core audiences with specification of how knowledge can be used
Valuation	Scientific aspects of process and output are valued	Process <i>or</i> output aspect relating to social practices are valued	Process <i>and</i> output aspects relating to social practices are valued

Table 2: Correlations between societal orientation and impact metrics

		Citation count	Altmetric Attention Score
Total	Rho	-0.003	0.125
	p-value	0.967	0.130
Motivation	Rho	-0.036	0.092
	p-value	0.668	0.267
Team	Rho	0.123	0.097
	p-value	0.139	0.241
Audience	Rho	-0.072	0.179
	p-value	0.389	0.030
Valuation	Rho	0.019	-0.086
	p-value	0.821	0.301

Significant values in bold

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