



# STI 2018 Leiden

*23rd International Conference on Science and Technology Indicators  
"Science, Technology and Innovation Indicators in Transition"*

## **STI 2018 Conference Proceedings**

*Proceedings of the 23rd International Conference on Science and Technology Indicators*

All papers published in this conference proceedings have been peer reviewed through a peer review process administered by the proceedings Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a conference proceedings.

### **Chair of the Conference**

Paul Wouters

### **Scientific Editors**

Rodrigo Costas  
Thomas Franssen  
Alfredo Yegros-Yegros

### **Layout**

Andrea Reyes Elizondo  
Suze van der Luijt-Jansen

The articles of this collection can be accessed at <https://hdl.handle.net/1887/64521>

ISBN: 978-90-9031204-0

© of the text: the authors

© 2018 Centre for Science and Technology Studies (CWTS), Leiden University, The Netherlands



This ARTICLE is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License

## Quantitative User Valuation Studies as means of scrutinization – The case of Altmetrics<sup>1</sup>

Stephan Gauch\*, Clemens Blümel\*\*

\* [stephan.gauch@hu-berlin.de](mailto:stephan.gauch@hu-berlin.de)

Research Group “Reflexive Metrics”, Humboldt Universität zu Berlin, Unter den Linden 6, Berlin, 10099 (Germany)

DZHW - German Centre for Higher Education Research & Science Studies (Berlin subsidiary), Schützenstraße 6a, Berlin, 10117 (Germany)

Chair of Innovation Economics, Technical University Berlin, Marchstraße 23, Berlin, 10587 (Germany)

\*\* [bluemel@dzhw.eu](mailto:bluemel@dzhw.eu)

DZHW - German Centre for Higher Education Research & Science Studies (Berlin subsidiary), Schützenstraße 6a, Berlin, 10117 (Germany)

### Introduction

The goal of this paper is to present an overview of the current modes of scrutinizations addressing the issue of a new quantified order of worth, the so called alternative metrics or altmetrics and propose an additional perspective that may help to contribute to a more thorough discussion on the reflexivity of these metrics. In general we propose three major modes of scrutinization that can be observed. These three modes of scrutinization address distinctive facets of establishing indicators and may even be universal to other forms of quantification. These modes have also been identified as main drivers in the history of webometry (Blümel et al., 2017).

### *Theoretical scrutinizations*

The lack of a coherent theoretical and conceptual framework regarding altmetrics is a shortcoming that has been discussed increasingly in the two recent years. Even though there exist a number of mostly conflicting theories regarding citations inspired by numerous disciplines such as psychology, sociology, rhetoric, information theory or even physical metaphors, a holistic theory of citation has not been presented yet. Altmetrics suffer in a similar way from this problematic heritage (Bornmann 2016b, also Moed 2005 for a general overview). Some very recent attempts highlight the necessity of such theoretical underpinnings once more such as Haustein et al. (Haustein, Bowman, Costas 2016). With the increasing prominence of altmetrics as a complementary set of indicators and new source of assessment, the recent years feature an increasing amount of contributions that articulate criticism towards these conceptual deficits (Gumpenberger et al. 2016). That issues has been also highlighted by a whitepaper on Alternative Metrics published by the National Information Standards Organization (NISO, 2014). While in the previous years, we find mostly scrutinizations that are aimed at cross-indicator validations (Erdt et al. 2016), we find increasing criticism towards such often atomized studies. These type of discussions include

---

<sup>1</sup> This work was supported through the OpenUp project funded by the European Union’s Horizon 2020 research and innovation programme under grant agreement No 710722.

both terminological issues as well as issues regarding the nature of impact that is deemed to be captured through Altmetrics (Bornmann 2014a, 2014b, 2016a; Calabuig et al. 2016; Cress 2014; Ferer 2016; Gutierrez et al. 2015). This shift in part reflects the re-emergence of argumentative patterns of the early phases of cybermetrics/webometrics research (eg. as found in Bossy 1995, also Blümel et al. 2017).

#### *Methodological scrutinizations*

The recent years in Altmetrics-related publications have been characterized by a surge of methodological scrutinizations towards Altmetrics (for a comprehensive overview see Erdt et al. 2016). Focusing on the most recent two years, this trend seems to be unbroken and will likely continue in the near future, especially with the increased integration of new sources of data under the umbrella term Altmetrics. Such attention has been often related to the influence of online social media platforms who are increasingly shaping and restricting societal and scholarly life (Cambrosio et al. 2009; Gillespie 2010, 2015; Keating and Cambrosio 2003). By providing not only means for social networking and sharing content, but also maintaining and controlling the technical infrastructures and channels for communication, platforms increasingly produce dependencies and create technical as well as societal power: ‘Platforms intervene’ (Gillespie 2015). Such dependencies can be also observed in the system of alternative scholarly communication and evaluation, which have been particularly shaped by the Altmetrics aggregators and their orchestration of data sources. Their selection and use of data sources surely contributes to what we have termed the acts of valuation of categorization in Altmetrics.

#### *Conceptual scrutinizations*

Most criticism towards Altmetrics is aimed at what altmetrics scores signify. A predominant issue is the interpretation of altmetrics reflecting societal impact or scholarly quality. Some scholars argue that Altmetrics measure „attention“ rather than scholarly quality, importance or impact (Franzen 2015; Haustein, S., Bowman, T. D., & Costas, R. 2015; Kortelainen and Katvala 2012): "Altmetrics do not, and probably cannot, serve the certification function of scholarship, a function that establishes the validity of a research finding. Altmetrics measure attention, not the soundness of an article’s data, methodologies, or findings." (Beall 2015: 2020). Against arguments of social media scholars who sometimes overrate the influence of social media in scholarly communication, Stefanie Haustein has put that more conceptual care is needed to grasp what kind of impact Altmetrics is producing: "In this context, it cannot be emphasized enough that social media activity does not equal social impact" (Haustein 2016). Similar positions are held by Melero (2015), who concludes that an indicator of discussion does not necessarily signal social impact (Melero 2015). Yet, other types of Altmetrics, such as assessment of citations towards publications in specific types of documents that reach beyond intra-scientific discourse such as clinical guidelines (Thelwall and Maflahi 2016) or policy documents (Konkiel et al. 2016) are argued to hold the potential for assessment of societal impact. Other scholars argue, that despite accepting a notion of attention being measured, such indicators for now do not reflect career-relevant forms of valuation. “Neither Twitter mentions nor Facebook ‘likes’ are, for now at any rate, accepted currencies in the academic marketplace; you are not going to get promoted for having been liked a lot.” (Cronin 2013: 1523). While such an assessment will have to stand the test of time and further progress, it probably falls short to capture the signalling power such indicators may have in specific disciplines, regardless of what they actually do or do not measure. Regarding career-specific aspects, some scholars argue that an increased importance of Altmetrics might hold the threat of goal displacement, while at the same time there is a lack of to “understand the underlying mechanisms of measures of attention” (Sugimoto 2015). Similar arguments are put

forward by Blackman (2016), who exclaims that Altmetrics are less aimed at modifying and empowering previously less appreciated forms of output, but rather reflect an increased automatization of the scholarly reward system (Blackman 2016). "In this sense, [Altmetrics] algorithms are part of a new micro-physics of power, which entangle material, psychological, cultural and historical processes as part of their automated logics. These extend beyond and have the potential to govern and shape the actions of individual users." (Blackman 2016: 19).

*The Role of the User - From user motivation studies to user valuation studies*

In recent years, we find several articles discussing the role of users and user properties. Most studies focus on the use of microblogging or social media services, with studies focussing on differences between user groups (Barthel et al. 2015; Holmberg and Thelwall 2014; Ortega, J. 2015; Ortega, J. 2015a), or academic rank or age (Mansour 2015; Mohammadi and Thelwall 2014; Mohammadi et al. 2015; Mohammadi et al. 2016a; Zahedi and van Eck 2014; Zahedi, Z., Costas, R., & Wouters, P. 2015) or gender differences (Bar-Ilan 2014; Birkholz, J.M., Seeber, M., & Holmberg, K. 2015; Paul-Hus et al. 2015, Tsou et al. 2015, 2015). Some studies specifically highlight the importance of user motivations (Haustein, Bowman, Holmberg et al. 2016; Mohammadi et al. 2016a; Ringelhan et al. 2015; Tsou et al. 2015). In contrast to studies from previous years, these user-based validation studies imply that Altmetrics has started to move beyond the initial stages of cross-metric and cross-domain validation studies and honouring the diversity of impacts and the need to assess these in their own right. Also, these types of studies seem to be motivated by the previously discussed conceptual scrutinization attempts that aim at delimiting the impact of individual Altmetrics data and methods to one dimension of impacts, but rather towards a multi-dimensional understanding of the impacts captured through Altmetrics. Such attempts are meaningful when the aim of understanding certain aspects of the relevance structure of users by opening up the perspective to a more generalized understanding of value. Also, disentangling the aspect of worth and media is in itself valuable as they allow to address the relationship between orders of worth embedded in individual forms of media and orders of worth of the systems to be related to each other, i.e. inter-scientific vs. intra-systemic communication, or, more precisely, if these type of communication channels are in and of themselves valuable which in its most radical form may result in the proclamation that the medium is the worth. Yet, in our opinion most studies neglect the crucial practice of valuation which becomes prevalent when the goal of understanding lies in the "valuation character" rather than the "communicative character" of social media and altmetrics. In short, the argument to extrude the point of view beyond motivations – a limitation in view that mainly stems from the aforementioned disciplinary perspective of psychology - is that indicators are supposed to capture outcome of behaviour that are deemed valuable in the context of a valuation system. Such a perspective can not plausibly be limited to the analysis of cross-correlation of indicators the likes of approaches of conceptual scrutinization, as such approaches may only serve the purpose of establishing a systematization of significances as a highly specific way of establishing coherence, rather than providing results on the level of meaning or even value attributed to the finalized product of quantifications – the indicators. This in no way aims at devaluing the efforts of user motivation studies or user-centered studies in general but rather advocates that motivations have to be analyzed in the context of perceived value of media both from the perspective of a more functionalist perspective more prevalent in information science as well as from the perspective of valuation and appraisal more prominent in sociological approaches of the link between action, norms, visibility and attention.

In the following we want to propose a first quantitative approach to account for the interrelation of motivation, functionalism and valuation through survey data collected among

researchers that is specifically aimed at relating perspectives of information science to sociology of science.

### **Data**

The analysis is based on the OpenUp survey conducted at the end of 2016 among researchers identified through their correspondence address. In total, 976 cases were collected. In order to allow for a granular analysis that takes into account both the level of career stage as well as a notion of disciplinary differences we had to merge respondents into broader fields due to the relatively low absolute number of early level researchers. Two fields were constructed to allow for comparison. One field comprises “Social Science & Humanities” (N=210), the other field consists of “Natural Science & Engineering” (N=608) and is based on a merge of respondents from natural science, engineering and computer science. The fields were chosen to represent rather differently focused fields that both in their methods as well as in their questions and research goals are rather different. For each of the disciplinary groups four different types of relevances and uses were analyzed. These represent the use of channels of disseminations as means of promoting and diffusing your work (Disseminate), as means of informing your work as a researcher (Inform), as a recognized and valuable activity within the respondents field (Appreciate) and as having potential to lead to societal impact (Society).

The four dimensions were covered by four survey questions: 1) "Which of these channels listed do you use most frequently to disseminate your own research to reach your target groups?" (Disseminate) 2) "How frequently do you use these sources to inform your professional work as a researcher?" (Inform) 3) "Please rate how being represented in these dissemination activities is generally appreciated within your field of research" (Appreciate) 4) "What potential do the following dissemination channels have to lead to a wider societal impact?" (Society) For each question a battery of dissemination channels was assessed on a 5-item end-point-scaled Likert scale. In total 19 channels of dissemination were assessed in the survey including one “other” category which did not enter analysis.

### **Methodology**

For each permutation of the groups to be analyzed, i.e. 2x2 table for natural science vs. social science and junior level researchers vs. senior level researcher, the share of respondents were calculated that assessed a channel as high or very high for each of the question relative to the total number of valid responses for these questions. The resulting data tables were then visualized using two-dimensional heat maps. The individual channels of dissemination were visualized as rows of the heat map. The columns of the heat map consist of the four uses (Disseminate, Inform, Appreciate, and Society). Each dimension was clustered based on the initial raw data for the group to be analyzed. The cluster analysis was based on a cosine-transformed distance matrix and employed the Ward algorithm as agglomeration method. The distance calculation was checked for robustness by using different distance functions. The heat maps were constructed to capture the range of 0 to 1, i.e. 0% to 100% of respondents. The shades of the heat map cells represent the percentage share of respondents assessing this combination of channel and use dimension as high or very high: the darker the shade, the higher the share. To allow for a better visual assessment, each cell includes a vertical line, which also comprises the value represented in the cell. Each heat map includes a color key to account for the overall distribution of the assessment.

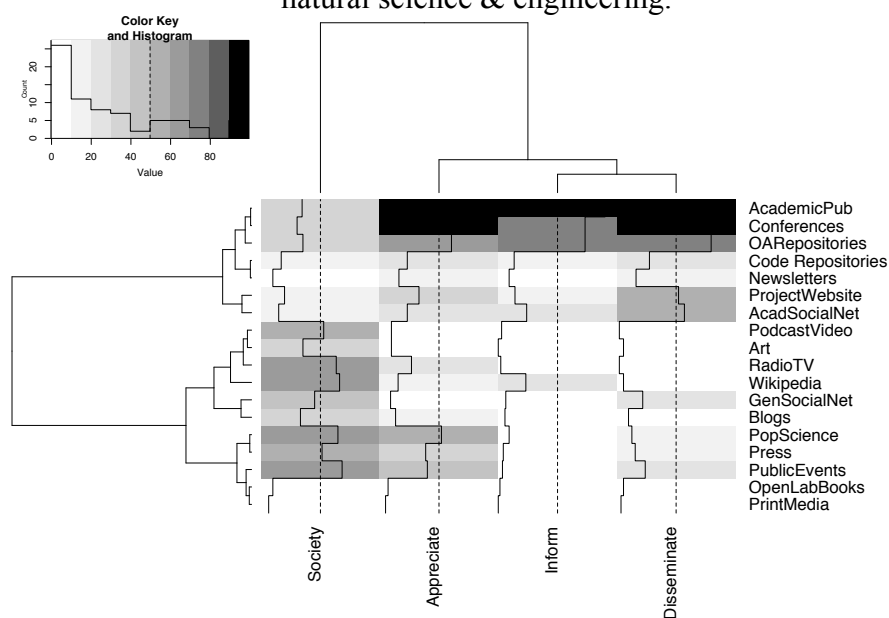
## Results

In a first step we assessed the inter-generational differences within each discipline, specifically taking into account In the second step we analyzed the intra-generational differences across disciplines.<sup>2</sup>

### *Natural Sciences & Engineering*

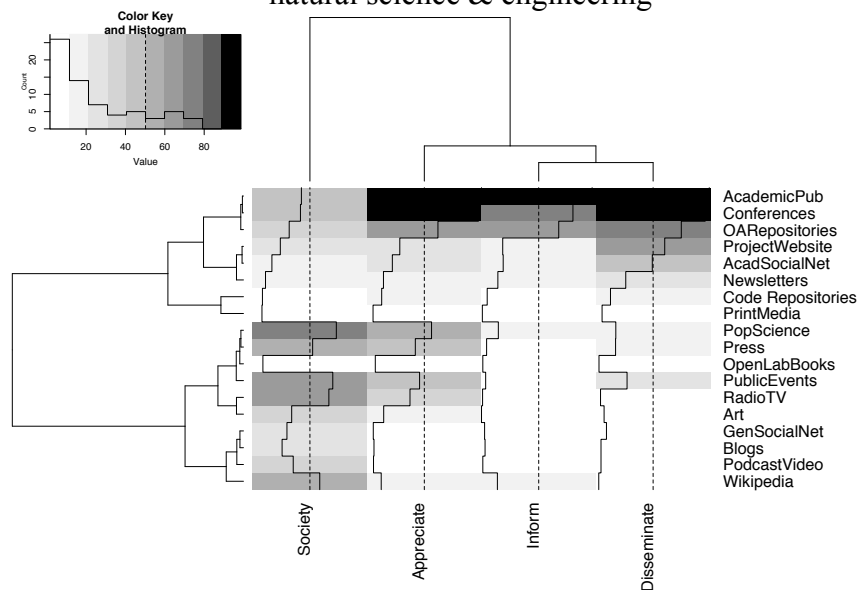
The results of our analysis for the discipline of natural science shows that there is a stable pattern of assessment for the dimensions of Dissemination, Appreciation and Information for traditional codified modes of knowledge diffusion through publications in peer-reviewed journals and conference proceedings (see Figure 1; Figure 2). Regarding innovative channels of dissemination we find that natural science juniors assess a higher societal impact of Podcasts and web-based Videos ( $p < .001$ ), and activities on generic social networks ( $p < .001$ ), compared to natural science seniors. Similar is true but to a lesser extent for Wikis ( $p < .05$ ), Blogs ( $p < .1$ ) and Code Repositories ( $p < .1$ ).

Figure 1: Heat map of assessment of dissemination channels for junior researchers from natural science & engineering.



<sup>2</sup> Comparisons are based on Mann-Whitney tests performed on the ordinal variables. P values are adjusted to control the false discovery rate (Benjamini & Yekutieli, 2001).

Figure 2: Heat map of assessment of dissemination channels for senior researchers from natural science & engineering



### *Social Science & Humanities*

In the case of Social Science & Humanities (see Figure 3; Figure 4) we find a similar pattern regarding established modes of codified knowledge dissemination with high values in the Inform, Disseminate & Appreciate Dimensions and average values for Societal Impact. We also find that, especially for social science junior researchers the pattern of differentiation between different channels regarding their societal impact is less clear cut compared to the situation in the natural sciences. In contrast, we find a much cleared cut notion of appreciation within the field for social science senior researchers compared to all other cases we analyzed. For social science seniors appreciation for innovative forms of dissemination is assessed as rather low. Like in the case of natural science & engineering we find a pronounced difference in the assessment of societal impact for Podcasts & web-based videos ( $p < .001$ ) and generic social network activities ( $p < .001$ ) with significantly more junior researchers assessing a high level of societal impact for these channels. We also find that in the case of Social Science & Humanities the share of junior researchers attributing high potential for societal impact is uniformly higher in all dimensions compared to their senior counterparts. Yet, these differences are not statistically significant and might be a statistical artefact.

### *Cross-disciplinary assessment*

Comparing both junior level and senior level researchers between fields shows that regarding the dimension of societal impact natural science seniors generally seem to attribute a higher societal impact on all dissemination channels compared to senior level researchers in the social sciences. The highest differences can be found for OpenAccess Repositories ( $p < .05$ ), Wikis ( $p < .1$ ) and Art ( $p < .1$ ). Regarding the comparison on junior level we find the opposite effect with natural science juniors seeming more sceptical compared to their social science counterparts. The strongest differences we find for activities in generic social networks ( $p < .05$ ) as well as academic social networks ( $p < .05$ ) and to a lesser extend for Popular Science ( $p < .1$ ). This result suggests that in Natural Science & Engineering there is a stronger harmonized inter-generationally shared notion of valuation regimes both regarding the three dimensions of Disseminate, Inform & Appreciate as well as regarding Societal Impact. In the social sciences & humanities these valuation regimes seem to differ more in terms of the

breadth of assessment of the impact of channels of dissemination on societal impact. Overall, junior level researchers seem to be more open to the idea of societal impact of innovative dissemination channels. Yet, these differences are not uniformly statistically significant.

Figure 3: Heat map of assessment of dissemination channels for junior researchers from social science & humanities

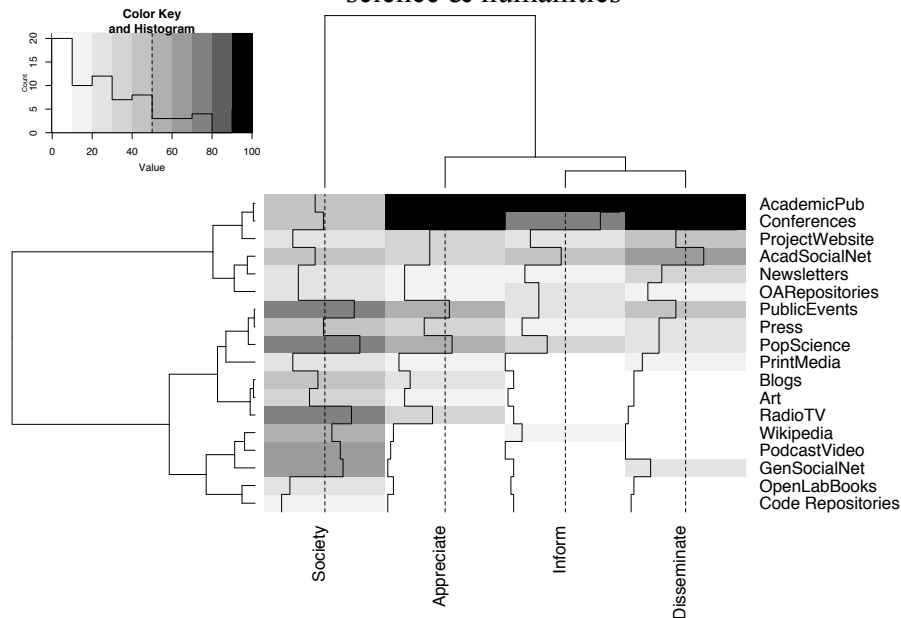
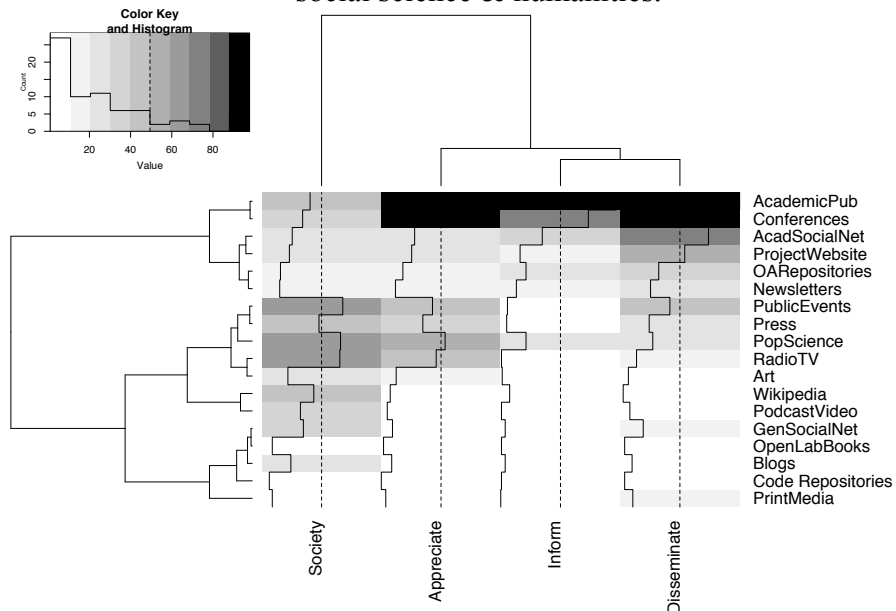


Figure 4: Heat map of assessment of dissemination channels for senior researchers from social science & humanities.



### Conclusions and Outlook

Even though, these clusters of dissemination channels seem to be largely robust across the analyzed groups the actual extent of each channel on the four dimensions rather than the structural similarities differ across groups. Yet, they can provide useful information representing substitution channels that share similar properties on the Disseminate, Inform,

Appreciate, Society dimensions. As mentioned in the introductory part of this paper, such an assessment has to be made with caution relative to the target group addressed. Using the data at hand, we can only assess the notions of researcher's vis-à-vis their assessment of societal impact. Moreover, we are not able to discern crucial analytical distinction between attribution, valuation and comparison (Krüger & Reinhart, 2016). Also, there seems to be evidence for a lack of harmonization between practices of communication and expectations towards valuation practices – a dischord that would go completely unnoticed focussing on either of the two exclusively. Naturally, one might argue from an evolutionary standpoint that indicators, similar to emerging fields of science in general, have to prevail the test of pragmatic usefulness, a world-to-indicator-fit, by striking a balance between irritation and confirmation. Confirmation by the means of connecting notions towards the captured latent concepts and results of indicators – Irritation by means of pointing out deficitary moments or even crisis. Still, the temporal density in which altmetrics indicators evolved from concept to notions of legitimate means of evaluation is nothing short of astounding and suggests that a swift understanding of altmetrics in the context of notions, practices and mechanisms of valuation and evaluation is necessary. These notions go beyond the mere level of application of an indicator. Also, the discussion may not benefit from a focus on incentivization because such a perspective will immediately confound proposed meaning of an indicator with the relevance of the underlying activities weakening the potential for constructive and fruitful critique towards altmetrics. Second, the current debate underestimates effects of the temporal structure in which both underlying practices of constructing both meaning and relevance of an indicator unfold.<sup>3</sup>

How then can user valuation studies benefit the discussion on altmetrics? First of all, it provides the empirical basis for challenging the current mode of theoretical scrutinizations in the present discussion without alienating structures of communication from structures of valuation. Second, it can contribute to the methodological scrutinization activities that can currently be observed by relating differences in valuation of certain channels of communication with weighting schemes. Currently, weighting schemes of the different channels of communication are opaque which is not surprising as there is a lack of evidence how this weighing scheme might reflect appreciated contents or outlets. A problem altmetrics share with composite indicators which among other aspects are also frequently criticized for incomprehensible weighting schemes. Weighting acts according to the notions of valuable contribution of these acts seem more plausible and possible through addressing user valuation. This is not to be confused with the issue of normalization of indicators which conceptually fix valuation of a specific social act and attests over- or underrepresentativeness for a distinctive category deemed relevant for a legitimate comparison. Third, and maybe most importantly user valuation studies may benefit conceptual scrutinization activities beyond a perspective of exogenous incentivization to engage in certain communication activities or simplified arguments such as “it does not correlate with citations – therefore it must be some other type of impact”. It also stresses the relevance of addressing the recommendation of the EC HLEG on altmetrics towards what should be measured condensed in the formula “Measure what matters!” (Wilsdon et al., 2017). It is left to say that strengthening the perspective of user valuation will require further more elaborate modes of analysis including both quantitative as well as qualitative methods. The presented contribution is but a starting point. Most notably the notion of who are the “users” in user valuation studies have to be more elaborated to go from “Measure what matters!” to addressing the question: “To whom?” or maybe even more relevant: “What if what is valuable to stakeholder group A is not at all valuable to stakeholder group B? Is this a problem? Do we have to account for

---

<sup>3</sup> The prominent discourse on “gaming” is a clear sign of this confounded perspective.

that? How?”. “Do structures of valuations provide a comprehensive answer to all the three modes of current scrutinization?” - “Can these scrutinizations be adequately addressed without them?” To both questions the answer is: “Most certainly not!”

## References

- Bar-Ilan, J. (2014) ‘Astrophysics publications on arXiv, Scopus and Mendeley: A case study’, *Scientometrics*, 100/1: 217–25.
- Barthel, S., Tönnies, S., Köhncke, B. and Siehdnel, P. et al. (2015). ‘What does Twitter Measure?’. In: P. L. Bogen, S. Allard, H. Mercer and M. Beck et al. (eds) the 15th ACM/IEEE-CE:, pp. 119–28.
- Beall, J. (2015) ‘The "Metric" System: Yet More Chaos in Scholarly Publishing’, *Journal of Physical Chemistry Letters*, 6/11: 2020–1.
- Birkholz, J.M., Seeber, M., & Holmberg, K. (2015). ‘Drivers of Higher Education Institutions' Visibility: A Study of UK HEIs Social Media Use vs. Organizational Characteristics’. In: A. A. Salah, Y. Tonta, C. R. Sugimoto and U. Al (eds) Proceedings of Issi 2015 Istanbul: 15th International Society of Scientometrics and Informetrics Conference:, pp. 502–13. Istanbul.
- Blackman, L. (2016) ‘Social Media and the Politics of Small Data: Post Publication Peer Review and Academic Value’, *Theory Culture & Society*, 33/4: 3–26.
- Blümel, C., Gauch, S., Beng, F. (2017) Altmetrics and its intellectual predecessors: Patterns of argumentation and conceptual development, Proceedings of the Science Technology Indicators Conference 2017, Paris.
- Bornmann, L. (2014a) ‘Do altmetrics point to the broader impact of research?: An overview of benefits and disadvantages of altmetrics’, *Journal of Informetrics*, 8/4: 895–903.
- Bornmann, L. (2014b) ‘Validity of altmetrics data for measuring societal impact: A study using data from Altmetric and F1000Prime’, *Journal of Informetrics*, 8/4: 935–50.
- Bornmann, L. (2015) ‘Letter to the Editor: On the conceptualisation and theorisation of the impact caused by publications’, *Scientometrics*, 103/3: 1145–8.
- Bornmann, L. (2016a). ‘Scientific Revolution in Scientometrics: the Broadening of Impact from Citation to Societal’. In: C. R. Sugimoto (ed.) *Theories of Informetrics and Scholarly Communication: A Festschrift in Honor of Blaise Cronin*, pp. 347–59. Berlin: de Gruyter.
- Bornmann, L. (2016b) ‘What do altmetrics counts mean? A plea for content analyses’, *Journal of the Association for Information Science and Technology*, 67/4: 1016–7.
- Bossy, M. J. (1995) ‘The Last of the Litter: 'Netometrics'’, *Solaris*, 2.
- Cambrosio, A., Keating, P., Bourret, P. and Mustar, P. et al. (2009). ‘Genomic platform and hybrid formations’. In: P. Atkinson, P. Glasner and M. Lock (eds) *Handbook of Genetics and Society: Mapping the new genomic era:*, p. 502-520. New York: Routledge.

Cress, P. E. (2014) 'Using altmetrics and social media to supplement impact factor: maximizing your article's academic and societal impact', *Aesthetic surgery journal*, 34/7: 1123–6.

Cronin, B. (2001) 'Bibliometrics and beyond: some thoughts on web-based citation analysis'.

Cronin, B. (2013) 'The evolving indicator space (iSpace)', *Journal of the American Society for Information Science and Technology*, 64/8: 1523–5.

Erdt, M., Nagarajan, A., Sin, S.-C. J. and Theng, Y.-L. (2016) 'Altmetrics: An analysis of the state-of-the-art in measuring research impact on social media', *Scientometrics*, 109/2: 1117–66.

Ferer, E. (2016) 'Meaningful Metrics: A 21st-Century Librarian's Guide to Bibliometrics, Altmetrics, and Research Impact', *College & Research Libraries*, 77/3: 397–8.

Franzen, M. (2015) 'Der Impact Faktor war gestern', *Soziale Welt*, 66/2: 225–42.

Gillespie, T. (2010) 'The politics of 'platforms'', *New Media & Society*, 12/3: 347–64.

Gillespie, T. (2015) 'Platforms Intervene', *Social Media + Society*, 1/1.

Gumpenberger, C., Glänzel, W. and Gorraiz, J. (2016) 'The ecstasy and the agony of the altmetric score', *Scientometrics*, 108/2: 977–82.

Gutierrez, F., Beall, J. and Forero, D. A. (2015) 'Spurious alternative impact factors: The scale of the problem from an academic perspective', *Bioessays*, 37/5: 474–6.

Haustein, S. (2016) 'Grand challenges in altmetrics: heterogeneity, data quality and dependencies', *Scientometrics*, 108/1: 413–23.

Haustein, S., Bowman, T. D., Holmberg, K. and Tsou, A. et al. (2016) 'Tweets as impact indicators: Examining the implications of automated "bot" accounts on Twitter', *Journal of the Association for Information Science and Technology*, 67/1: 232–8.

Haustein, S., Bowman, T. D. and Costas, R. (2016) 'Interpreting "altmetrics": viewing acts on social media through the lens of citation and social theories', In C. R. Sugimoto (Ed.), *Theories of Informetrics and Scholarly Communication* (pp. 372–405). Berlin: de Gruyter Mouton.

Haustein, S., Costas, R. and Larivière, V. (2015) 'Characterizing social media metrics of scholarly papers: the effect of document properties and collaboration patterns', *PLoS ONE*, 10/3: e0120495.

Holmberg, K. and Thelwall, M. (2014) 'Disciplinary differences in Twitter scholarly communication', *Scientometrics*, 101/2: 1027–42.

Keating, P. and Cambrosio, A. (2003) *Biomedical Platforms: Realigning the Normal and the Pathological in Late-Twentieth-Century Medicine*. Cambridge Massachusetts: MIT Press.

Konkiel, S., Sugimoto, C. and Williams, S. (2016) 'The Use of Altmetrics in Promotion and Tenure', *Educause Review*, March / April 2016: 54–5.

Kortelainen, T. and Katvala, M. (2012) "Everything is plentiful—Except attention". Attention data of scientific journals on social web tools', *Journal of Informetrics*, 6/4: 661–8.

Krüger, A., Reinhart, M. (2016) 'Wert, Werte, (Be)Wertungen – Ansätze für eine Soziologie des Wertens und Bewertens', *Berliner Journal für Soziologie*, 3-4/2016.

Mansour, E. A. H. (2015) 'The use of Social Networking Sites (SNSs) by the faculty members of the School of Library & Information Science, PAAET, Kuwait', *The Electronic Library*, 33/3: 524–46.

Moed, H. (2005) *Citation Analysis in Research Evaluation*. Dordrecht: Springer.

Mohammadi, E., Thelwall, M., Haustein, S. and Larivière, V. (2015) 'Who reads research articles?: An altmetrics analysis of Mendeley user categories', *Journal of the Association for Information Science and Technology*, 66/9: 1832–46.

Mohammadi, E., Thelwall, M. and Kousha, K. (2016a) 'Can Mendeley bookmarks reflect readership?: A survey of user motivations', *Journal of the Association for Information Science and Technology*, 67/5: 1198–209.

Mohammadi, E., Thelwall, M. and Kousha, K. (2016b) 'Can Mendeley bookmarks reflect readership? A survey of user motivations', *Journal of the Association for Information Science and Technology*, 67/5: 1198–209.

Mohammadi, E. and Thelwall, M. (2014) 'Mendeley readership altmetrics for the social sciences and humanities: Research evaluation and knowledge flows', *Journal of the Association for Information Science and Technology*, 65/8: 1627–38.

Ortega, J. (2015) 'Disciplinary differences in the use of academic social networking sites', *Online Information Review*, 39/4: 520–36.

Ortega, J. (2015a) 'Relationship between altmetric and bibliometric indicators across academic social sites: The case of CSIC's members', *Journal of Informetrics*, 9/1: 39–49.

Paul-Hus, A., Sugimoto, C. R., Haustein, S. and Larivière, V. (2015). 'Is there a gender gap in social media metrics?'. In: A. A. Salah, Y. Tonta, C. R. Sugimoto and U. Al (eds) *Proceedings of Issi 2015 Istanbul: 15th International Society of Scientometrics and Informetrics Conference*, pp. 37–45. Istanbul.

Ringelhan, S., Wollersheim, J. and Welppe, I. M. (2015) 'I like, I cite? Do Facebook likes predict the impact of scientific work?', *PLoS ONE*, 10/8: e0134389.

Sugimoto, C. R. (2015) "Attention is not impact" and other challenges for altmetrics, <<http://exchanges.wiley.com/blog/2015/06/24/attention-is-not-impact-and-other-challenges-foraltmetrics/#comment-2097762855>>.

Thelwall, M. and Maflahi, N. (2016) ‘Guideline references and academic citations as evidence of the clinical value of health research’, *Journal of the Association for Information Science and Technology*, 67/4: 960–6.

Tsou, A., Bowman, T., Ghazinejad, A. and Sugimoto, C. R. (2015). ‘Who tweets about science?’. In: A. A. Salah, Y. Tonta, C. R. Sugimoto and U. Al (eds) *Proceedings of Issi 2015 Istanbul: 15th International Society of Scientometrics and Informetrics Conference*., pp. 95–100. Istanbul.

Wilsdon, J., Bar-Ilan, J., Frodeman, R., Lex, E., Peters, I., Wouters, P. (2017) *Next-generation metrics: Responsible metrics and evaluation for open science. Report of the European Commission Expert Group on Altmetrics, EC Directorate-General for Research and Innovation, European Commission.*

Zahedi, Z., Costas, R., & Wouters, P. (2015). ‘Do Mendeley readership counts help to filter highly cited WoS publications better than average citation impact of journals (JCS)?’. In: A. A. Salah, Y. Tonta, C. R. Sugimoto and U. Al (eds) *Proceedings of Issi 2015 Istanbul: 15th International Society of Scientometrics and Informetrics Conference: Istanbul.*

Zahedi, Z. and van Eck, N. J. (2014) *Visualizing readership activity of Mendeley users using VOSviewer*. Bloomington, IN, USA.