# Are Altmetrics Proxies or Complements to Citations for Assessing Impact in Computer Science?

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***Abstract*—Altmetrics represent an alternative to established citation-based metrics to measure the scientific impact of a publication. For instance, they cover social-media platforms (e.g., Twitter, YouTube) to elicit how individuals outside of the scientific community interact with publications. Still, it is somewhat unclear to what extent Altmetrics are a valuable addition to existing metrics, or may represent only proxies without additional value. In this paper, we present our current steps towards understanding this problem in more detail. To this end, we describe and discuss the results of an initial correlation study that revealed significant positive correlations of different strengths between four categories of Altmetrics and citations. We elaborate on potential causes for, and the impact of, these correlations to define steps for future research aimed at understanding the value of Altmetrics.**

***Index Terms*—Altmetrics, Literature analysis, Quality**

## I. Introduction

Since 2010, *Altmetrics* have emerged as an alternative to traditional publication metrics (e.g., citation count, h-index, impact factor) to measure the scholarly impact of publications [1]. Altmetrics build on usage data, for instance, the number of downloads, views, and saves of a publication; and how the audience engages with a publication on social-media platforms, such as Facebook or Twitter. Major pros of Altmetrics are their quick accumulation through the web and their ability to reflect immediate feedback of a community. Although the research community is still not completely convinced with the accuracy of Altmetrics (e.g., they can easily be manipulated), there is sufficient evidence on their usefulness in terms of speed, diversity, ease of access, and coverage of different platforms [2]. So, researchers are actively involved in investigating the feasibility of Altmetrics for assessing the importance of a publication.

Several Altmetrics providers, such as Plum Analytics,[1] Altmetrics Explorer,[2] and ImpactStory[3] have been developed to aggregate data from different sources, for example, YouTube, Twitter, Wikipedia, and Mendeley. These providers collect statistics in a structured manner by summarizing and potentially weighting individual factors. The increasing popularity of Altmetrics and extended support by digital libraries, such as Scopus, led to researchers analyzing their use as a means of retrieving and assessing relevant publications within their fields. In that direction, Altmetrics may facilitate the conduct of literature reviews, which usually involve a large number of publications that could be semi-automatically ordered and assessed, which represents a highly demanded support mechanism [3].

As a step towards semi-automatic quality assessments of publications, we aim to understand the value of Altmetrics in guiding analysts while retrieving and analyzing publications. For this purpose, we conducted a study to determine whether the altmetric categories in PlumX (i.e., captures, usage, social media, mentions) correlate with citations. Thus, we intend to understand whether these categories can predict or complement citation counts as a traditional metric.

[1]http://www.plumanalytics.com/about.html
[2]http://altmetric.com/
[3]http://impactstory.org/

## II. Altmetrics

Citations are based on the references a publication receives from other publications. Since this implies some sort of scientific value, citations have become a commonly used measure of research performance. Aiming to tackle the limitations of plain citation numbers, various extensions have been proposed, such as h-index, CiteScore, or Field-Weighted Citation Impact—which are supported by several digital libraries [4]. However, since citations usually take time to accumulate, Altmetrics have been investigated as a means to reflect scientific impact besides citations.

For instance, PlumX provides four categories of Altmetrics:

**Usage** summarizes several values, such as, abstract views, full-text downloads, and the number of URL clicks.

**Mentions** indicate how often other people engage with a publication through blogs, comments, and reviews.

**Social Media** indicates interactions on social-media platforms, such as, Facebook, Twitter, Amazon, and YouTube, based on the number of likes, tweets, and shares.

**Captures** track the audience's interest based on, for example, the number of readers, bookmarks, and citation exports.

Even though Altmetrics aim to elicit the audience's engagement with publications through the web, each category reflects differently on such interactions and has individual coverage, sources, and availability of data. Thus, we believe it is meaningful to study the significance of the individual categories to understand how they reflect on (the quality of) a publication.

## III. Methodology

For our study, we constructed a dataset by identifying the most popular (as of March 2021) computer-science conferences and

TABLE I: Overview of Spearman's rank-correlation coefficient ($\rho$) for each PlumX category compared to citation counts.

| PlumX metrics | $\rho$ | p-value |
|---|---|---|
| Captures | +0.68 | <0.01 |
| Usage | +0.26 | <0.01 |
| Social Media | +0.25 | <0.01 |
| Mentions | +0.13 | <0.01 |

journals via Guide2Research,[4] a public database that uses well-established metrics (e.g., h-index, citations) to rank venues within the computer-science domain. We selected seven highly-ranked venues that were also included in Scopus, which allowed us to retrieve the desired metrics.

Our dataset involves a sample of the following four conferences and three journals:

- Conference on Computer and Communications Security,
- Conference on Human Factors in Computing Systems,
- International Conference on Robotics and Automation,
- International Conference on Software Engineering,
- Information Fusion,
- Science Robotics, and
- Transactions on Pattern Analysis and Machine Intelligence.

The broad range of venues helps us to cover various communities within computer science, for instance, software engineering, information security, robotics, and machine learning. Then, we used Scopus to retrieve the citation counts and Altmetrics of all publications that have been published at these venues between 2015 and 2021 (last updated in March 2021).

## IV. Results

Our resulting dataset comprises 16,545 publications. In Table I, we present the results of Spearman's rank correlation to compare each category of Altmetrics to the citation count of the publications. We defined a confidence interval of 0.05 and adapted it according to the (conservative) Bonferroni correction for multiple hypotheses testing, resulting in a corrected confidence interval of 0.0125 (i.e., 0.05 divided through four tests).

As we can see, all Altmetrics categories seem to be significantly correlated to the citation counts of publications (i.e., all p-values < 0.01). While all tests reveal a positive correlation coefficient (i.e., the Altmetrics category align to the number of citations), the strength of the effect size varies heavily. Namely, we found only one strong correlation, between captures and citations counts. All other correlations are rather weak, particularly regarding mentions.

## V. Discussion

Our results reveal weak to strong positive correlations between each of the four Altmetrics categories and citation counts. However, the causation and implications for the individual categories are far more interesting and subject to our future work. The main question is, whether Altmetrics categories are only proxies of citation counts (e.g., seeing the strong correlation to captures) or could be reasonable complements (e.g., seeing the far weaker correlations to other categories)? In the following, we briefly discuss two core insights that are relevant for this research direction.

**Potential causation and implications.** Captures have the strongest correlation with citations counts. Intuitively, this is not surprising, since this category involves how the audience interacts directly with a publication, for instance, how often the publication is downloaded. Consequently, captures imply that a researcher is actually interested, and thus will read and potentially cite, a publication. So, it seems that captures are a proxy for citations that may serve as an earlier indicator for scientific impact. However, to determine the actual causation and impact of a category, we have to consider several other aspects as well, for instance, what data sources are covered, the quality of the data, and how researchers perceive the value of a category. For instance, the other categories are only weakly correlated to citation counts. This may imply that they reflect on other audiences (e.g., viewers on YouTube) besides the scientific community. Thus, researchers may consider these categories valuable to complement citation counts and provide a broader perspective on scientific impact. Studying the individual relationships and their value to research is part of our future work.

**Evolution of Altmetrics.** Not surprisingly, since Altmetrics are a rather new concept, we found that only a fraction of the publications in our dataset comprise Altmetrics (mostly captures). We observe that the more recent data (i.e., 2018–2021) involve more and more Altmetrics. Still, we faced considerable data-quality issues that should be addressed to facilitate the use of Altmetrics and to make them more precise as well as reliable. This is rather a task for the tool providers and maintainers of digital libraries, which is why we aim to collaborate closely with them. As a concrete example, the Altmetrics provided in individual tools are diverse and accessible through completely different interfaces. We argue that it would help researchers, the digital libraries, and particularly tools for literature analyses to provide standardized Altmetrics and interfaces to access them.

## VI. Conclusion

In this paper, we investigated the correlations of Altmetrics with citation counts to understand whether Altmetrics could serve as proxies or complements for citations. We conducted a study that revealed significant positive correlations between each Altmetrics category and citations. Moreover, we discussed potential causes for these correlations and how they could impact research. However, understanding the details of these correlations and addressing the challenges of using Altmetrics are part of our future work.

[4]https://www.guide2research.com/

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