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Investigating the quality of interactions and public engagement around scientific papers on Twitter

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A R T I C L E   I N F O

A B S T R A C T

This study explores science communication on Twitter by investigating a sample of tweets referring to academic papers in five different scientific fields. The specifications of science communicators on Twitter, the characteristics of those who initiate actions (by tweeting), the extent and quality of reactions (retweeting), individual and group interactions, and the distribution of tweets across types of engagement in the process of science communication (i.e., dissemination, consultation, and evaluation) were explored. A broad array of actors is involved in the communication of science on Twitter, with individual citizens and individual researchers playing an important role. In principle, this is promising for creating direct interaction, which can be difficult through more traditional mass media. The vast majority of communication activities regarding academic papers is undigested dissemination with almost no sign of debate, contestation, or collective reflection. Another general finding of this study is that bot accounts play a major role in the science communication landscape on Twitter.

1. Introduction

Scientists are increasingly using the social web to discover new research opportunities, new ways of interacting with colleagues, and new means of disseminating information (Rowlands, Nicholas, Russell, Canty, & Watkinson, 2011). An article may be shared and discussed by peers and the public on social media within few hours of its publication, leading to a new mode of scholarly communication whereby a broader community is able to participate in discussions and disseminate research findings to their own online networks. Tracking and analyzing such events can expose where and how research has influenced people, as well as demonstrating the impact of research beyond academia. It has been suggested that social networking sites such as Twitter promote this type of wider information sharing (Forkosh-Baruch & Hershkovitz, 2011). Twitter offers a site for instant, casual communication about science and constitutes an interesting case to explore for at least two reasons. First, Twitter could potentially be part of the solution to what Cheng et al. (2008): 1) identified as a dual problem within the field of science communication: the inability of the actors and the inadequacy of the means. Twitter can be a meeting point for a very diverse set of actors, who can consume, contribute, and contest science following an easy recipe for engagement. Kahle, Sharon, and Baram-Tsabari (2016) argue that social media like Twitter may facilitate direct interaction between scientists and different members of the public better than traditional media. Second, Twitter is an

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interesting case due to the rapidly emerging impact agenda in science policy (Wilsdon et al., 2015). Along with other social media, Twitter may lead to changes in how the academic and societal impact of science are assessed.

The research area of altmetrics has proposed the investigation of the use of the social web for research evaluation (Priem & Hemminger, 2010). Altmetrics involves counting the number of "mentions" of various research products from online sources (e.g., Twitter, Facebook, news outlets, or blogs), the assumption being that such mentions could ascertain something about the audiences interacting with research products online and the wider impact of research (Priem, 2014). However, the quality and reliability of altmetric platforms for research evaluation purposes remain a matter of debate and require more qualitative evaluations.

Twitter is one of the most important sources of data for altmetric analyses, as research outputs are widely shared on this platform. Twitter can be used by scientists to publicize their research (Thelwall, Tsou, Weingart, Holmberg, & Haustein, 2013), yet, the reasons why an article becomes popular on Twitter are not entirely clear: An article may gain popularity on Twitter because it reports fraud or due to retraction of the article (Marcus & Oransky, 2011), or a humorous/light title or content may capture attention (Didegah, Bowman, Bowman, & Hartley, 2016). Moreover, automated bots on Twitter add to the uncertainty about the patterns of science communication on Twitter and raise doubts concerning the platform's reliability as a data source for analyses.

A growing number of studies address the issue of how science is being communicated through Twitter, and they try to delineate the actors involved in this form of science communication. A few articles have studied the type of users who tweet academic research, but their results differ due to the different methods and user classifications applied to identify Twitter users. In a large-scale study of articles in 27 subject categories, more than 85% of users tweeting articles were found to be a member of the public (Yu, 2017), while a small-scale study of 15 top-tweeted Finnish articles reported a high percentage of healthcare professionals in Medical and Health Sciences, and a high percentage of businessmen in Social Sciences and Humanities (Vainio & Holmberg, 2017). The former study was based on Altmetric.com data and user classification that has some limitations and deficiencies, such as Twitter accounts with a blank bio being categorized under "the member of public" rather than a "blank or unknown" category (Altmetric.com). The implication is that classification of 85% of tweeters of articles as members of the public is likely to be a gross overestimate. Further limitations of this classification are explained in Tsou, Bowman, Ghazinejad, and Sugimoto (2015) and will be further discussed in Section 3. The latter study was conducted through a content analysis of profile descriptions and classified users into 17 categories based on the words and explanations provided by the user. Yet another classification was proposed in Haustein, Bowman et al. (2016), Haustein, Tsou et al. (2016), which examined a random sample of 200 users tweeting research articles. The users were classified into four groups of "brokers," "orators," "broadcasters," and "mumblers" based on two criteria: engagement (whether tweet content only contains article title or any extra text) and exposure (number of followers). The users were also identified as an individual or organization in each of the aforementioned categories, the results showing that 68% of the users were individuals. In sum, analyses of the profiles of Twitter users tweeting scientific articles are starting to emerge, but there is not yet any standard classification of users.

Scrutinizing tweet content, Thelwall et al. (2013) investigated tweets of a sample of academic papers in a collection of journals, finding that more than 95% of the tweets were neutral and did not hold any opinion about the paper. Likewise, analysis of 2016 tweets of a collection of psychology articles showed that most were neutral, although around 17% of them aimed at recommending the papers as an interesting source (Na, 2015). In a study of disciplinary differences in tweeting research articles, most disciplines tended to be conversational (meaning they were addressing another account through @-ing) (Holmberg & Thelwall, 2014).

While the present study is concerned with similar issues, it has a disciplinary approach and investigates the quality of interactions and engagement around research objects from different subject domains on Twitter. Moreover, this paper mainly aims to study how far the general public is engaged in and initiates interactions around research objects and whether bot accounts and duplicate accounts result in a "false popularity" of papers on Twitter.

2. Research questions

This study explores the properties of science communication on Twitter by studying tweets linking to academic papers across all fields of science. The composition of participants on Twitter, the extent and quality of reactions (in retweeting), appeals to individual (by @-ing) and group (by #-ing) interactions, and the distribution of tweets across types of engagement in the science communication process (i.e., dissemination, consultation, and evaluation) are examined. The characteristics of those who initiate actions around research objects on Twitter are examined for the first time. Issues of humor in Twitter-based science communication and the extent to which automated tweeting (i.e., tweeting by "bots") influences the quality of this platform for science communication purposes are also studied. In line with these objectives, the following specific questions are addressed:

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- What type of users are tweeting articles? How many of them are bot accounts?
- Which type of users are most likely to be initiators of article tweets?
- What is the quality of the interaction around research articles on Twitter?
- What type of engagement can be identified around research articles on Twitter? Is there any evaluation or consultation involved?