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Editorial: The Science-Media Interface – On the relation between internal and external science communication

The publication and distribution of scientific results is of major importance for knowledge societies (Stehr, 1994; Castelfranchi, 2007), especially in the face of the complex and multifaceted challenges in today's world. This volume takes as its starting point a twofold interest in the communicative interplay between science and the mass media. First, the ways in which "scientific facts" as the result of scientific research, discourse, and shared conventions (Fleck, 2019 [1935]) become part of public communication, especially through journalism. Second, the ways in which public communication about, and especially journalistic representations of and references to, scientific knowledge affect processes of knowledge production, scientific discourse, and allocation of reputation within science. Major actors in this interface are researchers themselves, professional science communicators and science journalists, but also platforms and intermediary organizations that curate scientific research for distribution into mass media. Each of these have their own approach to the selection, presentation and mediation of scientific knowledge. To highlight different aspects of the science-media interface, this volume integrates perspectives from scientometrics and quantitative science studies, and from communication science and journalism studies.

The concepts of *internal* and *external science communication* are useful for distinguishing the communication practices by which scientific knowledge is produced, verified, shared, and acknowledged within the scientific community from those by which it is communicated and engaged with outside of the scientific community (Leßmöllmann & Gloning, 2019). The rise of digital media has, however, led to a refiguration of science communication, characterized by new actors, practices and orientations (Broer & Hasebrink, 2022) and a blurring of traditional role divisions between the production, evaluation and dissemination of science (Franzen, 2019; Neuberger et al., 2019). As the works in this volume highlight, the boundaries between internal and external science communication are permeable, resulting in deeply interwoven relationships affecting both forms of science communication.

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Within the domain of science, the scholarly community uses distinct practices of internal science communication to produce, distribute and verify scientific knowledge in what is typically referred to as "scholarly communication" (Borgman, 1989, p. 586). Fields such as quantitative science studies or scientometrics invest great efforts into understanding how scientific knowledge is produced and exchanged within and between scientific communities (and in some cases between academia and industry or policy, see for instance Leydesdorff & Meyer, 2003). This is often driven by the objective of quantifying impacts that indicate the influence or relevance of academic journals or individual research endeavors.

So far, the field of quantitative science studies has remained largely introspective. Increasing interest in the consequences of open science, and potential indicators for measuring the societal impact of research (Tahamtan & Bornmann, 2020) may reflect a shift. However, even within the extensive body of literature on research impact indicators (e.g., citations, usage metrics, altmetrics), research into the scientific impact of external science communication, e.g., in terms of science reporting, blogging or social media activities, seems to still be in its infancy. Although the exact nature of the relationship has remained unclear, limited studies do indicate a connection between mentions of scientific publications in news articles and social media platforms, and their scientific impact (see, e.g., Fanelli, 2013; Dumas-Mallet et al., 2020; Phillips et al., 1991). So, given the variety of formats from external science communication only more influencing factors and relationships seem to be awaiting exploration.

The transformations that occur when representations of scientific knowledge move beyond the boundaries of science into other social contexts have been described as "popularization" (Fleck, 2019 [1935]; Hilgartner, 1990). It can be argued that this process occurs on a continuum: on the way from the esoteric knowledge communities where scientific knowledge was originally generated, it is communicated with increasing certainty in order to make abstract ideas concrete (Bauer, 2017; Cloitre & Shinn, 1985; Hilgartner, 1990). The news media have traditionally played an important role in the public communication of science, which is why research on external science communication has often focused on the role of journalism. In some normative models of science communication, the news media are idealized as conduits and problematized as distorters in the transmission of scientific knowledge to the wider public (Mede & Schäfer, 2020). In this view, journalistic practices associated with making scientific knowledge fit for public consumption are linked to concerns about simplification, decontextualization and a loss of accuracy (Berg, 2018). However, as journalism-oriented research has pointed out, news media operate according to their own logics

(Kohring, 2005). The practices within science reporting and the quality of journalistic representations of science should therefore be analyzed according to the professional norms of journalism, not science. In this view, science journalists take on a range of societal roles from gatekeeping, contextualizing, to critically observing science (Fahy & Nisbet, 2011).

The interface between science and media is, however, affected by several trends. On the side of science, researchers are facing pressure to increase their scientific output in order to positively impact the quantitative metrics that are used to determine academic standing and which are necessary for career progression (i.e., "publish or perish"). In addition, there is a usually normatively argued push towards open access in academic publishing (Taubert et al., 2019) and towards sharing of research results as early as possible. While not new, sharing scientific findings before completing the academic peer review process in so-called preprints has gained traction, particularly with regard to COVID-19 research (Fraser et al., 2021). In sum, there is not only a surge in scientific output, but also in outlets where scientific findings can be freely accessed.

Individual researchers and research institutions are furthermore increasingly engaging in external science communication practices, e.g., via science blogging, social media activities, as well as press announcements about new research. On the one hand, these efforts are a way to fulfill normative expectations, such as sharing scientific knowledge to inform citizens and politicians, and justify public expenditures on scientific research (Renn, 2017). On the other hand, strategic science communication helps scientific actors gain public visibility, which in turn may enhance the reputation of research institutions and individual scientists, and attract funding (Weingart & Joubert, 2019; Väliveroonen, 2021; Raupp, 2017).

At the same time, traditional mass media are undergoing rapid change due to digital communication technologies. A loss of advertising and subscription revenue has led to budget cuts and a greater reliance on non-specialist and freelance journalists (Dunwoody, 2021). In the face of the abovementioned surge in scientific output and outlets, and scientific actors' increased efforts to gain public visibility, shorter production times and a lack of specialists in journalism have brought about concerns about the quality of science reporting, and the extent to which journalistic roles are being fulfilled. Studies into so-called "churnalism" have found significant reliance on press releases from universities and journals in science reporting (Heyl et al., 2020; Vogler & Schäfer, 2020).

The pursuit of media attention by scientific actors can also have implications for science itself, as the discourse on the mediatization of science suggests (see

Rödder et al. 2012 for an overview). This research area is concerned with the effects of tendencies within science to orient scientific research and publication processes towards journalistic criteria of relevance in order to gain media attention, rather than towards internal scientific criteria of relevance. Finally, it is interesting to note that scientists and journalists appear to be facing many of the same constraints: a push to produce more content in less time and the need to search, select, verify, contextualize and evaluate a rapidly growing amount of scientific output that is available in ever more outlets.

1 Content summary

The order in which the individual chapters within this volume are presented mirrors an exemplary chronological sequence in which scientific and journalistic publishing may affect each other. In this sequence, a bulk of findings from the scientific sphere enters the journalistic sphere via press releases from academic publishers or institutions (Chapter 1). In navigating this information, intermediaries like Science Media Centers provide journalists with curated science news and expertise (Chapter 2), while preprints give journalists early access to new, though unverified, scientific findings (Chapter 3). The resulting media coverage may in turn affect the degree of attention given to research within the field of science (Chapter 4): A feedback mechanism with potential implications for the methods that scientists rely on to evaluate research (Chapter 5). The final chapter concludes this volume with a critical discussion of such feedback mechanisms' plausibility along the concept of medialization (Chapter 6).

All chapters within this volume were peer-reviewed individually. Several of the chapters originated from the research project "MeWiKo - Medien und wissenschaftliche Kommunikation [Media and Scholarly Communication]", which was funded over three years by the German Federal Ministry of Education and Research – this refers to the Chapters 2, 4, and 5. This edited volume can therefore also be considered a representation of some of the MeWiKo-project's core results, which in this publication get embedded and contextualized within recent works of other contributors stemming from scientometrics, science studies, communication science, and journalism research.

In this volume's first chapter, *Orduña-Malea & Costas (Chapter 1)* contribute to opening up one of the most common formats of (external) science communication – press releases – for the field of scientometrics. The authors present a theoretical framework for the analysis of science-related press releases, based on

principles common in scientometric research. As an illustrative example, the authors perform a descriptive analysis of the press release data available on EurekAlert.org, its coverage regarding press release types, disciplines, years, continents, submitters, and journals, as well as of the web- and Twitter-links to EurekAlert! press releases in the past. Within their chapter, Orduna-Malea & Costas present a helpful theoretical assessment of EurekAlert! in the context of science communication. At the same time, their empirical results provide interesting insights into the data behind the indubitably important player that EurekAlert! has become in the dissemination of science news.

In the second chapter, *Broer (Chapter 2)* investigates how Science Media Centers as important but understudied intermediaries between science and journalism, contribute to the construction of science news. By reporting results from an ethnographic study of Science Media Center Germany, Broer outlines the routines with which this organization curates scientific knowledge and expertise for journalistic distribution. These include restricting the scope of covered scientific topics, applying scientific, social, and journalistic relevance criteria, relying on external expertise, and timing broadcasts with the intention of promoting, altering, or preventing coverage of science issues. She argues that in this process, the editors negotiate implicit and explicit knowledge about science and journalism in an effort to bridge the professional norms of these fields.

Simons and Schniedermann (Chapter 3) continue with a further chapter strongly related to the COVID-19 pandemic's effects on science journalism. The authors present a systematic case study on the coverage and framing of scientific preprints within a large sample of German news stories over the years directly before and during the pandemic. Simons & Schniedermann display a rich collection of both quantitative and qualitative analyses, which, among other aspects, illustrate the heavy reliance of journalism on preprints in COVID-19-related news stories since the beginning of the pandemic. Their findings also provide highly interesting insights into how German journalism tended to frame preprint-based information with regard to dimensions such as uncertainty or timeliness, and how such framings appeared to change over time.

In this volume's next part, *Brede, Mazarakis and Peters (Chapter 4)* approach the topic of how journalistic stories on research might affect the attention that covered research articles themselves receive. More precisely, the authors utilize an approach based on conjoint analysis to examine which features of scientific articles, if portrayed in journalistic coverage, may lead to researchers looking up said original articles after encountering them within public media. Brede et al. hereby investigate potential drivers that could explain associations between science's presence in journalism and metrics commonly used to evaluate scientific

impact. The results indicate that the features with an inferred external judgment were the most useful. In addition, one of the most important elements influencing the effect advantage may be the supplementary, thematically, and methodologically categorized information that a news article may provide.

The subsequent chapter by *Lemke, Mazarakis and Peters (Chapter 5)* expands upon this connection between research's coverage in external science communication and impact metrics. Moreover, the authors provide a concrete example for an empirical analysis examining press releases in a scientometric context (see also Chapter 1). Lemke et al. combine press release data from EurekAlert! with data on embargo e-mails, bibliometric indicators, and altmetrics, to estimate path models that indicate the substantial interdependencies between the presence of research articles in science communication and metrics commonly used as indicators of impact. The large-scale approach by Lemke et al. reveals the significant degree to which science communication and scientometric impact metrics are linked to each other.

In this volume's last chapter, *Lehmkuhl, Promies and Leidecker-Sandmann (Chapter 6)* assess a much-discussed claim about the dynamics between science and journalism: the thesis of the medialization of science, or more specifically, the included assumption that journalism in a kind of feedback mechanism affects the practices of scientific actors, which, according to the medialization thesis, in turn increasingly adapt to journalistic selection logics. Lehmkuhl et al. compile and discuss various studies' findings concerning one central premise of this assumption, namely journalism's performance in creating and concentrating public attention for science. From their evaluation, the authors conclude that the empirical studies provide hardly any evidence for journalism's success in focusing public attention on certain scientific results or actors – which, as Lehmkuhl et al. argue, would be a prerequisite of central importance for the plausibility of the medialization thesis. With their findings, the authors provide thought-provoking new input to the discussion of one of the over the past decades arguably most prevalent theoretical conceptions of the relationship between science and journalistic media.

2 Contribution

The chapters presented within this volume cover a wide range of approaches, from theoretical considerations on the interplay of academic and journalistic communication of science to practical applications of related data sources. Likewise, the main learnings from the presented studies touch upon a large variety of

aspects related to the science-media interface, e.g., how scientometric methods can be utilized to gather insights from and about outputs of external science communication, what the processing of scientific content within journalistic media currently looks like and how it changed during the COVID-19 pandemic, and how researchers might react to the way external science communication depicts science. Thus, it is one of the first volumes that has successfully collected and contextualized up-to-date research from a variety of disciplines that deal with the journalistic and scientific spheres and the sphere in which science and media meet and overlap. The volume sets a particular spotlight on the changing practices of internal and external science communication induced by different forms of publishing and communicating scientific results, such as preprints, press releases, and embargo e-mails, and how those affect (science) journalism and quantitative science studies. We thus believe this edited collection to offer content relevant for a variety of readers, including but not limited to researchers and students from the fields of science communication, scholarly communication, the science of science, science journalism, bibliometrics, information science, journalism studies, communication science, or sociology of science; as well as other stakeholders from, for instance, domains of science policy.

This volume's contents also indicate the abundance of opportunities for further research at the intersection between subject fields traditionally dealing with the analysis of scientific systems of knowledge creation (e.g., scientometrics, sociology of science, science and technology studies) and those researching the workings of journalism and public communication of science (e.g., media and communication studies, journalism studies). Throughout this volume, a recurring observation in this regard concerns the remaining need for more research on the factors and mechanisms that guide actions and decisions by the diverse stakeholders involved in the public communication of research findings. How, for instance, do press offices select research publications for their promotional activities, to which degree are traditional news values applicable to science journalism (see also Franzen, 2014; Badenschier & Wormer, 2012), how do journalists reflect their increasing use of preprints (see also Fleerackers et al., 2022), how do researchers perceive accounts of science within external science communication, etc.. In many instances the contributions within this volume indicate (and demonstrate) how the aforementioned fields of research can benefit from more extensive mutual exchange, either on the level of theories, models, methodologies, or data sources. Moreover, the amount of remaining research demand revealed within the chapters underlines that such exchange will remain beneficial in the long run.

Finally, it should be noted that the majority of studies presented in this volume were performed during the COVID-19 pandemic – a time when the relationship between science and media received increased public attention as it repeatedly became the subject of discussion within public media. Starting from the early days of the pandemic, the normative roles of journalism in disseminating scientific findings to non-academic audiences were discussed as openly as perhaps never before. Researchers, on the other hand, in many examples demonstrated the immediacy with which their insights can nowadays be brought into the public discourse, be it via postings or open letters shared across social media, or via rising scientific publication formats such as podcasts or preprints (Watson, 2022; see also Chapter 3). Among many other things, the COVID-19 crisis has highlighted the importance for both journalists and researchers to exhibit responsibility in their public communication of research, and thus the necessity for the scientific and the journalistic sphere to profoundly understand each other's modes of communication. We hope that this volume dedicated to previously under-researched phenomena unfolding at the science-media interface will contribute to such understanding.

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