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Scientific and Parascientific Communication

Edited by

Pilar Mur-Dueñas and Rosa Lorés

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About the Editors

Pilar Mur-Dueñas is a senior lecturer in the Department of English and German Studies at the Universidad de Zaragoza (Spain). Her research focuses on the analysis of multilingual scholars' discursive practices in English. She has explored scholars' publication practices and her more recent research focuses on the analysis of scholars' digital practices and scientific communication delving into how the digital medium can shape academic genres and influence the lexical and discursive choices made when scholars disseminate their research widely. She has co-edited the books *Constructing Interpersonality: Multiple Perspectives on Written Academic Genres* (Cambridge Scholars Publishing, 2010) and *Intercultural Perspectives on Research Writing* (John Benjamins, 2018), and published the results of her research widely in national and international journals. (<https://www.researchgate.net/profile/PilarMurDuenas>).

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Editorial

When Science Communication Becomes Parascience: Blurred Boundaries, Diffuse Roles

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The communication of science goes hand in hand with technological development and, in general, with the need to apply scientific advancements to the improvement of human wellbeing. The publication of scientific journal articles became a milestone for modern science, as academics shared an interest in research output being available to all other scholars [1], with the scientific community as the privileged audience with access to new knowledge. However, since the second half of the twentieth century, researchers have increasingly been required to go beyond the publication of their results in high-impact journals, usually English medium, only accessible to their peers both in terms of knowledge availability and understanding, and to communicate and disseminate their findings in varied contexts among different agents and audiences in an attempt to democratise access to science. Science communication to various types of non-specialist publics has been understood as a “crucial responsibility of research scientists” [2] to facilitate citizens’ understanding of complex knowledge and their participation in decision-making processes. Moreover, communicating scientific knowledge and engaging the public is currently of paramount importance for funding and accountability reasons. The use of the digital medium has fostered such dissemination and access to knowledge, rendering digital discursive practices increasingly complex for scholars and scientists, who need to embrace multimodal and multimedia means of communication. Research findings and implications must reach not only multiple stakeholders, but also an audience of laypeople.

As such, dissemination is undertaken in new ways, modes and discourses that seek to bring science closer to society and to promote citizens’ participation. The affordances of existing and emergent platforms are fostering a change in audience roles, and with it, the erosion of boundaries between scientific communities and the general public, which entails disseminating scientific information and knowledge [3].

Within this context, we are witnessing the development of a type of discursive practices, which can be referred to as instances of “parascientific communication”. These practices go beyond the dichotomy between internal or expert (members of the scientific community) and external or non-expert (diverse publics) and transcend previously well-delimited communities and spheres of communication. Parascientific genres are evolving based on authoritative or expert knowledge (communicated through conventional, sanctioned scientific genres) but not subjected to the filters of internal, formal scientific communication [4]. In these genres, discourse “borrows scientific authority and knowledge structures from the realm of science but operates without the gatekeeping and traditional reporting forms of internal science communication. In other words, it borrows some features from the internal discourse of science without the whole complex of features upon which the epistemic authority of science depends” [4] (p. 231). In our view, parascientific communication contributes to the broad dissemination of science, empowering citizens, making them participants in advancements, offering them accessible answers to problems that may be complex for non-specialised audiences, and fostering their agency and participation [5]. This is largely achieved thanks to the affordances of the medium.

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The articles in this Special Issue contribute, in various ways and from different angles, to our understanding of how science is communicated and disseminated digitally. The studies include analyses of scientific and parascientific discursive practices across varied domains, such as Business [6], Chemistry [7], Physics and Astronomy, Medicine and Health, Biology and Life Sciences, as well as Earth and Environmental sciences [8]. They concern various topics of current impact and social interest, such as the press and social media coverage of the popular French scientist Didier Raoult [9], the communication of knowledge in the Harvard Business Review [6], COVID vaccines [10] and COVID-19 news [11]. They cover a myriad of scientific and parascientific genres: online readers' comments as user-generated text [10,11], press articles and tweets [9], video genres (Quick Study, Explainer, Tips and Ideas) [6], institutional and personal blogs [8] as well as a strategic proposal (Total SciComm) to broadly and diversely communicate science, from preprints to social and new media [12].

Promoting and easing participation from diverse audiences, including laypeople, can also pose risks and challenges, some of which are touched upon in the articles in this Special Issue. These include disinformation, or difficulty in disentangling speculation from reliable and contrasted information [10]; polemics and conflicts confronting legitimacy and authority [9]; trivialisation; entertainment, which does not necessarily come with ease of interpretation [7]; or the creation and spread of pseudoscientific information [11].

In our call for papers, we launched three sets of questions which are now answered by the results reported within this Special Issue, allowing us a better overall understanding of current scientific and parascientific communication.

To What Extent Does Parascientific Communication Differ from Scientific Communication? Which Features Characterise It/Them?

Parascientific communication takes greater advantage of the medium and platform affordances to foster readers' participation by means of commentaries and reactions, but seems at times to fail in possible opportunities to co-construct knowledge. On the one hand, such affordances seem to be effectively employed by users in media contexts, especially newspapers [10,11] and social media [9], in which readers make their contributions to the creation of knowledge. On the other hand, the corresponding affordances are not so commonly embraced by users in other contexts, such as the Harvard Business Review journal [6]. Moreover, whereas scientific communication through specialised discourse between experts tends to be linear and monosemic, expert–non-expert discourse tends to be non-linear and polysemic and takes advantage of a combination of different modes, which suits different levels of knowledge or expertise.

At a discursive level, parascientific communication seems to be characterised by a greater versatility and a wider range of resources aimed at explaining scientific matters in an accessible manner, as well as at promoting credibility, on the one hand, and dialogicity and closeness with the audience, on the other [6–8].

Which New Discoursal Practices Are Emerging in Response to Boundary Erosion in Scientific Communication? What Do They Entail? Who Undertakes These? What Functions do They Fulfil?

In an attempt to democratise science through its dissemination, new practices are emerging. Among the more innovative examples discussed in this Special Issue are videos shared on Facebook [6], graphical abstracts [7] and users' online comments [10,11]. Nevertheless, many other practices can and should be undertaken to communicate scientific ideas and engage all scientists as part of the Total SciCommon strategy proposed by [12], which encompasses scientific film and video, scientific games, scientific art and the scientific novel. These practices are undertaken by experts, journalists and citizens, who can easily respond to scientific topics and controversies. Whereas scientific communication constitutes legitimised, sanctioned knowledge, this needs to be brought closer to the audience and to diverse stakeholders through parascientific communication responses to which can become pseudoscience [11].

Can Well Established Methodological Approaches Be Useful and Valid to Explore Digital Communication, Either in a Scientific or Parascientific Context? What New Perspectives Might Contribute to the Exploration of New Practices?

A well established perspective such as Genre Theory, which approaches textual instances as social action, seems to be useful and valid to explore digital scientific and parascientific communication, although it has to be necessarily combined with other frameworks, among which multimodality seems most pertinent [6,7]. Of particular interest is the analysis of knowledge communication from a multimodal perspective, which encompasses knowledge expansion and knowledge enhancement processes proposed and applied by [6] to the study of the semiotic modes which contribute to making meaning in the interplay between texts and different types of video in the context of the Harvard Business Review. The study of genres has been further combined with other concepts and approaches, such as dialogicity [8], credibility [10] and distance and closeness [11]. New concepts within digital humanities such as textometry [9], which allows us to understand the themes of a corpus through the lexical words used in texts, has also proven highly insightful for the analysis of scientific digital discourse. Most studies have combined quantitative and qualitative analyses to address their object of study, to reveal discursive and social tendencies, but most importantly, to interpret them in the context of global scientific communication in general and, in particular, scientific or parascientific communication through the selected digital practice, genre or platform.

Overall, the contributions included in this Special Issue identify new digital practices of scientific communication, signal unexplored conceptual paths and propose innovative ways of applying existing methods for their study. Taken together, we believe that the seven papers that form this Special Issue will inspire future research and shed light on the diffuse landscape of digital science communication and dissemination.

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- Ho, M.-T.; Ho, M.-T.; Vuong, Q.-H. Total SciComm: A Strategy for Communicating Open Science. *Publications* **2021**, *9*, 31. [[CrossRef](#)]



Article

Multimodal Generic Trends of *Harvard Business Review* Knowledge Communication in and beyond Social Media Context: Exploiting Affordances, Neglecting Opportunities

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Abstract: This article is part of an on-going research project dedicated to enhancing our understanding of domain-specific knowledge communication across various multiliterate communities, semiotic modes and media contexts. The focus of the present analytical endeavour is on the dissemination of knowledge of academics from the domain of business and management to professionals and other non-academic communicative partners in the context of the *Harvard Business Review* journal. The central empirical material is constituted by a cluster of videos selected from the Facebook context of the journal whose intention is to function as a bridge between academia and enterprises. For this bridging effort, a number of video genres which are not traditionally used for scientific knowledge communication in academic contexts (e.g., Quick Study, Explainers, Tips & Ideas, etc.) are employed. Furthermore, in accordance with the Facebook context, the videos are accompanied by users' commentaries that evaluate the knowledge provided or/and contribute to communicating and co-constructing new knowledge. Finally, we include the articles, books and special issues to which the videos refer in the empirical study. This hybrid knowledge-communication setting is studied from a multimodal perspective in order to address the new ways in which semiotic modes and sub-modes enter into a meaning-making interplay at the level of each video and when users comment on the respective videos. The main analytical tools are the concepts of knowledge expansion and knowledge enhancement that characterize the interaction of modes in the knowledge-building process. Across the video genres that have been investigated, we see a tendency towards engaging users of the videos through diminishing the distance to the viewers. As a consequence, the videos have a high number of views, but at the same time there are few comments and hardly any comments engaging in mutual knowledge building. This paradox is discussed in more detail in the concluding section.

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Keywords: knowledge communication; knowledge-building processes; multimodality; social media engagement

1. Introduction

The communication of academic knowledge is not restricted to the academic sphere. According to Hyland [1] (p. 1), modern academic discourse is aimed at “educating students, demonstrating learning, disseminating ideas and constructing knowledge”. However, from a practical as well as an analytical point of view (due to the differences in the factors characterizing and influencing the different discourses), it may be relevant to be able to keep different parts of academic discourse apart and distinguish between scientific and “parascientific” communication. According to Kelly and Miller [2] (p. 224), the term “parascientific” should cover “a variety of genres that do not fit clearly into the more traditional internal/external binary”. They characterise such genres as being “concerned with the collection, arrangement, or application of scientific knowledge in contexts formally external to but somehow involved with the scientific community” [2] (p. 231).

A case in point, which we have already been investigating in previous studies [3,4], is what could be called the *Harvard Business Review* (HBR) universe. HBR states that they

intend to function as a “bridge between academia and enterprises” (<https://hbr.org/corporate/about>, accessed on 9 January 2022) through different outlets and media. At the centre of this universe, we find the *Harvard Business Review*, which originally was a printed journal, but now exists in both print and online formats. Supplementing the journal is a book company, Harvard Business Review Press, issuing a large range of different types of books. The parascientific character of this enterprise lies in the fact that the articles and books published in the *HBR* universe are written by researchers based upon their own research and address users with a similar education as the researchers, though working outside the academic context. In other words, not academic, but practical, experts with practice-related goals are the receivers of this scientific knowledge.

The *HBR* universe consists not only of the two original and thus primary outlets mentioned above. Instead, they also exploit a major and multifaceted online platform offering many different genres disseminating knowledge relevant for business practitioners at different levels of detail, expertise, etc. As we have demonstrated in our previous studies, *HBR* is not only interested in disseminating scientifically-based knowledge through their communicative efforts. An important parallel goal of the variety of genres used for disseminating more or less the same knowledge for *HBR* is to promote its different products through parascientific communication.

In order to comply with this goal, *HBR* has built a modern online platform, integrated also with different Web 2.0 technologies such as social media (Facebook, YouTube, et al.). Exploiting Web 2.0 technologies means introducing communication channels that enable moderators and users to interact directly, as such technologies open up forums where users may react directly to the communicated content. In other words, Web 2.0 technologies may be seen as a context of knowledge communication that potentially generates a much more complex interactivity in the presentation and mutual elaboration of scientific knowledge [5] (pp. 11, 64). Hence, adopting such technologies for communicating academic knowledge on social media platforms means creating at least the possibility of engaging the users in an interaction. On this basis, researchers have claimed that “focusing on engagement with science and research content on social media should be an important part of research on science communication” [6] (p. 1). With the present study we want to test methods for answering this call.

In our qualitative study, we explore the multimodal knowledge-building processes appearing at the intersection between traditional research publications (books, articles, special issues), the videos based on these publications and the commentaries posted on Facebook by users for each of the selected videos. We elaborate on the multimodal aspects of knowledge-building processes in the selected data in order to investigate the degree to which affordances of the multimodal formats and the different semiotic modes enter into a meaning-making interplay both in each of the selected video genres and in users’ commentaries. By multimodal knowledge-building processes, we understand those knowledge-building processes that are made possible through the combination of several semiotic modes, from speech and written text to still and moving images.

When engaging in our analytical work, we concretely pursue three questions linked to the characteristics described above:

- What elements from the original research publications have been selected for making possible a series of knowledge-building processes in the investigated videos?
- What characterises the knowledge-building processes in the videos when comparing them to the texts introducing them?
- In what way do commentaries to the videos on Facebook and on YouTube contribute to the parascientific communication in this context?

In the next section (Section 2: Literature Review), we present the combination of theoretical approaches on which we have built the analysis reported here. This section is followed by Section 3, presenting the materials and methods applied in the analysis. Section 4 presents the empirical study, the results of which are discussed in Section 5.

2. Literature Review

In this section, we introduce three complementary conceptual frameworks that provide the theoretical background for the proposed research: knowledge communication, multimodality, and genre. We tap into the potential interface between these three concepts because it can provide new insights into all three areas of study. Obviously, knowledge communication and multimodality are both relevant concepts for the understanding and explanation of the selected empirical material, in which knowledge is built through the meaning-making interplay of several semiotic modes because: “Knowledge is made and given shape in representation, according to the potentials of modal affordances; the process of representation is identical to the shaping of knowledge. Makers of representations are shapers of knowledge” [7] (p. 27).

As “genre currently appears as a grey area between the social function of a multimodal artifact and its structure” [8] (p. 113), we consider that it is also relevant to define and explain this concept in the context of the present study.

2.1. Knowledge Communication

When taking a knowledge-communication approach, we study how experts communicate with experts and non-experts about their area of expertise with a focus upon processes of cognitive construction, multimodal representation and socially communicating expert knowledge [9] (pp. 228–229). The present object of study fits perfectly into this framework, as we look at videos through which experts convey expert knowledge to users of the HBR Facebook site in order to investigate authors’ decisions concerning the multimodal texts. The approach has its focus upon describing the interaction between information presented in different modalities (cf. Table 1 below) as a basis for knowledge-building processes to be carried out by the users when interacting with the multimodal texts.

Table 1. Explanatory overview of the types of multimodal knowledge-building processes.

Types of Multimodal Knowledge-Building Processes			
<i>Multimodal knowledge-expansion processes</i> Through the interaction of different modes, more aspects of the concepts treated may be built by the users.		<i>Multimodal knowledge enhancement processes</i> Through the interaction of different modes, the quality of the knowledge to be built by the users may be enhanced, especially in the form of more details.	
<i>Multimodal core knowledge-building processes</i> The additional aspects expand the central concepts treated, according to title, abstract, etc.	<i>Multimodal peripheral knowledge-building processes</i> The additional aspects expand background aspects of the concepts treated, typically aspects presupposed by experts.	<i>Evident enhancement of knowledge</i> The additional aspects offered enhance the quality of the knowledge by actually enabling the construction of new knowledge.	<i>Apparent enhancement of knowledge</i> The additional aspects offered only apparently enhance the quality of the knowledge to be constructed through repetition in more modalities.

Our analysis is built mainly on two different categorizations of processes, to which the multimodally offered information contributes: knowledge enhancement and knowledge expansion [9] (pp. 231–232).

In our analysis in Section 4.1 below, these categories are used to structure the analysis of multimodal knowledge-building processes.

2.2. Multimodality

We include multimodality in this study as we consider that multimodality should be at the core of knowledge communication research because the communicative building of knowledge always takes place at the intersection of several semiotic modes.

When looking with a multimodal lens even at a monochromatic textbook page without any images, it is possible to explain how layers of meaning are conveyed not only through the written words but also through typography, the layout of the page and the paper texture. Thus, several semiotic modes always contribute through their more or less

elaborated orchestration to constructing, maintaining or transforming meaning even in a seemingly monomodal text [10]. Furthermore, not only written language, but also “spoken language cannot be adequately understood without taking non-verbal communication into account” [11] (p. 688). When summing up the various approaches to investigating what happens between various semiotic modes in unfolding communication instances, Van Leeuwen concludes that the interplay of the semiotic modes is meaning-making because each mode contributes to conveying content, but depends on each other to convey the whole content [11]. It should be added here that we adopt Kress’ definition of a semiotic mode: “a mode is a socially shaped and culturally given semiotic resource for making meaning” [7] (p. 79).

Multimodality should be understood both as an inherent characteristic of communication and as a multidisciplinary field of study that encompasses educational applications, discourse studies, everyday situated interactions, etc. According to one of the newest definitions, “multimodality is the phenomenon that all communication integrates a range of meaning-making resources, that is, images, words, sound, etc.” [12] (p. 24). Simultaneously, multimodality has also to be understood as “a research orientation in its own right that seeks to address what happens when diverse communicative forms combine in the service of ‘making meaning’” [13] (p. 8). The multidisciplinary field study of multimodality has developed on the foundational premise that communication is always multimodal [7,10,11] and that “multimodality is not a novel phenomenon per se, but an innovative lens on the social world” [14] (p. 4). This field has grown exponentially through a vast range of research studies that investigate complex communicative artifacts and events from various social domains, cultural contexts and media: for example, films [15], websites [16], mobile news [17], (inter)actions [18], online shopping [12], etc. These communicative artifacts and events are investigated in terms of their multimodal combination and integration of several semiotic modes that may include not only written and/or spoken language, but also other semiotic modes. In all these communicative artifacts and events, the semiotic modes’ interplay can reinforce, nuance, complement or subvert the meanings produced at the level of each semiotic mode. From the multimodal researchers’ perspective, both the constraints and the affordances of each semiotic mode, as well as the modes’ specific interplay, create meaning and, consequently, our reality.

2.3. Genres

In our context, a relevant way of conceptualizing genres is to see them as “frames for social action that support researchers’ socioliterate activity” [5] (p. 4), following the work of researchers such as Miller, Swales and Bazerman. Hence, genres are tied to discourse communities with a focus on the formulation traditions generally accepted within the community. With a genre approach, we intend to explain conventionalized characteristics of (multimodal) expressions in a wide sense, typically from the point of view of the communicative situation and purpose(s) influencing text formulation. Hence, genres are generally accepted prototypical solutions to communicative tasks, viz. “researchers’ socioliterate activity”. Focus is upon what expectations communicators may have to texts emerging from a specific communication type: e.g., experienced researchers, especially from the field of natural sciences, expect a structure consisting of Introduction–Methods–Results and Discussion (IMRAD), when they recognize a text as a research paper. The reason is that nowadays this is the traditional, in fact almost canonical way of solving the communicative task of reporting research results, among other things due to the importance of empirical studies for natural sciences.

Apart from such traditions for solving communicative problems, genre characteristics may also be guided by the so-called affordances of the applied communicative instrument. We talk here about characteristics of (multimodal) texts that may be expected to appear due to basic traits of the communicative instrument. A case in point with relevance for our study here is the possibility on social media platforms such as Facebook and YouTube to interact with the video and with other viewers via comments. It is an affordance of social media as a

Web 2.0 technology that such interaction is possible due to characteristics in the underlying online technology. As this affordance has been taken up very pointedly in such media, it has become a part of the generic integrity [19], by which we mean that it has become part of the characteristic core of traits constituting the genre of these types of communicative instruments that Facebook posts and YouTube videos offer such possibilities of interaction through a commenting function.

As an example, Bucher [20] investigated in one of his analyses a corpus of around 400 YouTube videos on science topics in order to first categorize the videos into genres and secondly to study the degree to which the offered commenting function was actually being exploited in the corpus. In a first step [20] (p. 138) suggests four basic types of videos:

- Expert videos (videos focusing upon specific experts and their ideas)
- Narrative explanatory video (videos focusing upon telling a story through which the scientific topic is presented and argumentatively explained)
- Animated video (videos relying upon live drawings or schematic moving pictures in their presentation of a scientific topic)
- Presentation video (videos where a presenter renders the scientific topics while addressing the audience directly).

Bucher states that the first two types are typically found in television settings, while the two last-mentioned types are rather typical of the YouTube context.

In a second step, he then studies the comments reacting to the science videos and establishes the following types of comments [20] (pp. 139–140):

- Epistemological review (on the validity and relevance of the videos from a knowledge point of view)
- Knowledge dissemination (i.e., giving further information on the video's topic)
- Information on self (i.e., the commentators talk about themselves)
- Wishes for topics
- Reflexive comments (i.e., comments reflecting on the interaction)
- Evaluations (i.e., comments on the general value of the video)
- Relational work (i.e., comments working on the interpersonal relations)

In the corpus in general, comments giving an epistemological review (epistemische Würdigung) and knowledge dissemination comments are the most frequent, demonstrating an interest on the side of the commentators in interacting with the sender of the videos on the knowledge presented in them. Interestingly, Bucher also finds that of the total of 1216 comments for the 400 videos, 1154 are connected with Presentation videos or Animated videos, i.e., those that are more typical in a YouTube context, whereas the other types that may rather be recognized as belonging to a traditional TV setting hardly receive any comments (62 in total).

Bucher's last-mentioned result is interesting in our case, as it shows that an affordance (here: the possibility of commenting on videos presented online) may but does not have to become part of the generic integrity. On this basis, we are interested in investigating the commenting practice in connection with *HBR* videos, especially from the point of view of these comments as part of video-based knowledge communication in an *HBR* online setting. Hence, we will characterize the videos investigated according to their genre and investigate the commentaries emerging as reactions to the videos. Although the typology of commentaries has been developed for the study of YouTube videos and not comments to Facebook posts, we venture to use it here, as the videos investigated in this study are also posted on *HBR*'s YouTube channel and belong to the same type as those studied by Bucher, i.e., videos disseminating scientific results.

3. Materials and Methods

In the light of our focus on multimodal analysis of knowledge-building processes appearing across three different sources of empirical materials, we depart from the quantitative approach that is usually taken in social media studies and adopt a qualitative perspective.

As mentioned in the introduction, we have collected and analysed empirical material from three main sources: *HBR* videos posted by the organization on their Facebook wall, the users' commentaries posted in relation to each of the videos, and excerpts from the books or articles that have been the main knowledge sources of the *HBR* videos selected. The main knowledge source of the videos is in all cases indicated in the descriptions of the videos, often through the formulation "For more, read xx". We have explored six videos of various lengths belonging to three different *HBR* video genres (Quick Study, Explainer and Tips & Ideas) and the related books and articles. All the videos are accessible in the context of both the *HBR* website and the *HBR* Facebook wall. We have also explored 480 commentaries posted by FB users in relation to the videos selected (see Table 2 below for an overview of the empirical materials).

Table 2. Overview and description of the *HBR* genres selected.

Genre	Video's Title, Description and Length on <i>HBR</i> Website	Video's Title, Description and Length on Facebook Wall	Related Book/Article/Issue
Quick Study (Q1)	<i>Storytelling with Data: A Good Charts Workbook Tool.</i> In this video, Scott Berinato, author of <i>Good Charts</i> and <i>Good Charts Workbook</i> , walks through the three essential ingredients of any story—including those told with data. (9:31)	<i>Telling Stories with Data in 3 Steps.</i> Setup, conflict, and resolution—it's how storytelling works. You can tell stories with data the same way. (4:46)	<i>HBR</i> book: <i>Good Charts Workbook: Tips, Tools, and Exercises for Making Better Data Visualizations</i> [21]
Quick Study (Q2)	<i>Stopping Yourself from Acting On Bad Impulses.</i> Amy Jen Su. When you're about to reach for that sugary snack, micromanage a direct report, or snap at a coworker, pause and short-circuit the behavior before it begins. (3:59)	<i>Stopping Yourself from Acting On Bad Impulses.</i> Amy Jen Su. When you're about to reach for that sugary snack, micromanage a direct report, or snap at a coworker, pause and short-circuit the behavior before it begins. (4:00)	<i>HBR</i> book: <i>The leader you want to be: five essential principles for bringing out your best self—every day</i> [22]
Tips & Ideas (T1)	<i>Artificial Intelligence, Real Food.</i> Can AI really help you be more creative? We paired IBM's AI with an expert chef and a kitchen novice to see how humans and machines could work together. Here's what happened. For more, read "AI, For Real." (8:55)	<i>Artificial Intelligence, Real Food.</i> Can artificial intelligence come up with a delicious recipe? We enlisted a celebrity chef and an amateur cook to find out. (8:56)	<i>HBR</i> Big Ideas Issue: <i>AI, For Real</i> [23]
Tips & Ideas (T2)	<i>To Innovate, You Have to Manage the Past, Present, and Future.</i> Vijay Govindarajan, professor at the Tuck School of Business at Dartmouth College, explains how to create a new business while optimizing an already existing one. For more, read <i>The Three-Box Solution: A Strategy for Leading Innovation.</i> (10:53)	<i>To Innovate, You Have to Manage the Past, Present, and Future.</i> Your future weaknesses are embedded in your current strengths. That's why selectively forgetting the past is the biggest challenge. (10:54)	<i>HBR</i> book: <i>The three-box solution: A strategy for leading innovation</i> [24]
Explainer (E1)	<i>Why so few "Diversity Candidates" are hired.</i> Finalist pools can reinforce the status quo. For more, read "If There's Only One Woman in Your Candidate Pool, There's Statistically No Chance She'll Be Hired." (2:18)	<i>Why So Few "Diversity Candidates" Are Hired.</i> The relationship between finalist pools and actual hiring decisions. (2:19)	<i>HBR</i> article: <i>If there's only one woman in your candidate pool, there is statistically no chance she'll be hired</i> [25]
Explainer (E2)	<i>Big Data and Analytics.</i> What the two terms really mean—and how to effectively use each. For more, read <i>Big Data at Work: Dispelling the Myths, Uncovering the Opportunities.</i> (2:44)	<i>Big Data and Analytics.</i> What big data and analytics really mean—and how they can help your business. (2:45)	<i>HBR</i> book: big data @ work: <i>Dispelling the Myths, Uncovering the Opportunities</i> [26]

The research was performed in several stages. Before we started, as “multimodal analysis involves repeated viewing of the data” [27] (p. 186), we familiarized ourselves with the data through repeated viewings. Then, during the first stage, we coded and transcribed the empirical material from the *HBR* videos selected for recurring instances of specific knowledge-building processes. We included in Word tables all the knowledge-building processes identified in each part of each video in relation to the accompanying text appearing in the social media platform. During the second stage, we continued to work with the same tables, and we included the knowledge-building processes identified in the users’ comments to each video (see below Table 3). When we reached the third stage, new tables were created in order to systematize the data sets from the *HBR* videos and the books and articles that inspired the creation of the respective videos (see Table 4 below). Each of these tables was designed to capture the specificity of the multimodal knowledge-building processes in the contexts of the empirical materials selected and the research questions.

It should be highlighted here that, in order to truly understand our data multimodally, no semiotic mode was prioritized while identifying, transcribing and coding our sets of empirical material. Speech, written text, still images, moving images and other kinds of visualizations were all taken into consideration. Their relations of summarizing, complementing or reinforcing each other in the identified knowledge-building processes were examined in all the videos selected. However, in the case of each analysis we started with the verbal mode because it carries the main knowledge communication function (cf. Section 2.1). Obviously, a more detailed analytical stance could have directed attention to the meaning-making potential of other modes such as gesture, typography or colour, but for the present investigation we decided to avoid doing this. This decision was based upon the fact that our intention was not to provide full-fledged multimodal analyses of the videos, but of the knowledge-building processes made possible through a series of semiotic modes and their interplay. More details on the method underlying our results as well as more fine-grained analyses may be found in our previous work (e.g., [3,4]).

Finally, we identified the recurrent knowledge-building processes appearing in each type of empirical material. Both researchers were engaged independently in each of these analytical stages in order to be able to substantiate the interpretations in a valid manner.

Table 3. Excerpt from the analysis table of Q1 related to multimodal knowledge-building processes existing in the video and in the FB comments.

Genre Time	Types of Multimodal Knowledge-Building Processes			
	Multimodal Knowledge-Expansion Processes <i>Multimodal Peripheral Knowledge-Building Processes</i>	Multimodal Knowledge-Enhancement Processes <i>Evident Enhancement of Knowledge</i>	Multimodal Knowledge-Enhancement Processes <i>Apparent Enhancement of Knowledge</i>	
<p>Video's Title FB Information: Link, Date, Content Description, Reactions, Commentaries and Views</p> <p>Q1: Quick Study (09:31 min)</p> <p>Telling Stories with Data in 3 Steps. Setup, conflict, and resolution—it's how storytelling works. You can tell stories with data the same way.</p> <p>FB Link 13 January 2020 1000 reactions 36 commentaries 58,800 views</p>	<p>Q1: Each video chapter's main topics and steps visualized on separate screen (i.e., "Find the story. Identify the three elements in your data"), summarizing the explanations provided through speech.</p> <p>Q1: The researcher's name and the name of his book are superimposed on the close-up shot of the researcher while he is speaking, complementing verbally the information provided through the image.</p> <p>Q1: Non-existent</p> <p>FB: Non-existent</p>	<p>Q1: Non-existent</p> <p>FB: Non-existent</p>	<p>Q1: The main words uttered by the researcher are visually superimposed on the close-up ("Setup", "Conflict", "Resolution"), reinforcing the same meaning produced at the level of each semiotic mode.</p> <p>FB: "Wow! This is an extremely helpful example. Thank you. Could you please show more of these examples for storytelling with data?"</p>	

Table 4. Excerpt from the analysis table of the video Q1 focusing upon multimodal knowledge-building processes representing knowledge presented in [21].

Genre Video's Title HBR Link and Content Description Book Title	Types of Multimodal Knowledge-Building Processes		
	Multimodal Knowledge-Expansion Processes	Multimodal Knowledge-Enhancement Processes	
	<i>Multimodal Core Knowledge-Building Processes</i>	<i>Multimodal Peripheral Knowledge-Building Processes</i>	<i>Apparent Enhancement of Knowledge</i>
<p>Q1 Quick Study (09:31 min) Storytelling With Data: A Good Charts Workbook Tool. Scott Berinato, author of <i>Good Charts and Good Charts Workbook</i>, explains how storytelling with data is as simple as setup, conflict, and resolution. For more, read about the tool here: <i>Good Charts Workbook: Tips, Tools, and Exercises for Making Better Data Visualizations</i></p>	<p>The knowledge presented is all about the concepts of "Setup", "Conflict", and "Resolution" as components of storytelling and of persuasion. It is thus core knowledge in connection with the book presentation.</p>	<p>Examples and explanations for the concepts of "Setup", "Conflict", "Resolution" Distinguishing time-series data and non-time-series data settings. Instructions in the form of examples of finding the concepts of Setup, Conflict, Resolution in data. Instructions for using the concepts in data presentation. Elaborated example of finding the concepts and structuring presentation on this basis.</p>	<p>Presenting the elements of narration ("Setup", "Conflict", "Resolution") Presenting narration as a deeply human characteristic.</p>

4. Analytical Findings

4.1. Multimodal Knowledge Communication in HBR Genres

We start the presentation of our results by comparing the videos to the related publication (book, article, or *HBR* issue). Here, the focus is on the selections characterizing the videos and the combination of modes employed in the presentation of the selected items. This part of the analysis is based upon the kind of tables exemplified in Table 3. We also characterize the videos according to Bucher's typology. After that, we compare the actual videos with the short description accompanying the videos in the Facebook posts. Here, the focus is on how the knowledge introduced in the attention-catching short texts is spelled out and elaborated in the video.

4.1.1. Quick Study Genre

The book directly underlying the Q1 video [21] and referred to from the video is a workbook published by *HBR* that consists of instructions concerning skills relevant for creating charts (colour, clarity, chart types, persuasion, concepts), exercises training these skills, and discussions of solutions to the exercises. Hence, it is a self-study book for people wanting to be able to create good charts for presentations. In this case, the video on the *HBR* Facebook page is an abbreviated version of the video on the YouTube channel, which is also visible in the different verbal presentations of the video (cf. Table 2 above). We chose to analyse the longer version here in order to have as much material as possible to work with. The video is based upon one aspect out of six mentioned in the workbook's section on persuasion [21] (pp. 132–133). The short text on storytelling consists of 204 words, whereas the video in its YouTube version covers 9.31 min. Therefore, the video is a multimodal elaboration of a minor aspect in the book: three concepts connected to storytelling (Setup, Conflict, and Resolution) are at the centre of the video; they are explained, defined and exemplified, and instructions are given on how to find them in different types of data and how to apply them for telling a convincing story; finally, an elaborated example is presented. Interestingly, the brief text accompanying the video, mentions the workbook, but the link at the end connects to a kit consisting of an e-book version of the workbook, a video, a printable tool, reusable worksheets, and an *HBR* article on the topic. Furthermore, the workbook is related to a textbook without exercises, but with the same topic as the workbook [28]. Here we find a brief presentation of the idea of storytelling (460 words) consisting in introducing the structure constituted by "Setup", "Conflict" and "Resolution". This presentation, too, is much briefer than the video, but like the video it goes into the basics of finding the elements of the story in the idea underlying the presentation. By way of conclusion, the video is an elaboration of what is presented in the textbook and workbook, which can stand alone and which actually goes deeper and further than the books in presenting its topic. In Bucher's terms, it is a presentation video, in which the author of the book speaks directly to the user and presents a topic.

The book underlying the Q2 video [22] is a book aiming at teaching managers how to be better leaders in their relation to co-workers. It is built around five principles, one of which is Presence. In order to enhance one's capacity for presence, the book suggests working through three steps. The video is built upon elements from Step Two (Regulate: Find the Pause and Don't Scratch the Itch [22] (pp. 138–145)). Elements in the video are the same as in the book, but there are more and different examples. Furthermore, the order of the presentation is turned around, so that the different substeps presented in the video inductively lead to the conclusion (that leaders need to be more present in meetings and interactions with others). In the book, on the other hand, the argumentative structure is more deductive. Consequently, we have also here a stand-alone video, where the relation to the book is not explicit, but can be recognised, if one reads the book. Furthermore, the video is not an attempt to make a summary of the book. Instead, a small element is taken out and given an independent presentation. In Bucher's terms, it is a presentation video made by the book author, as the focus is upon presenting a topic.

As far as the multimodal knowledge expansion in the Quick Study genre is concerned in relation to the short descriptions accompanying the videos, both core and peripheral knowledge-building processes characterize the Quick Study genre. This genre contains a series of multimodal core knowledge-building processes that contribute also to the structural layout of the videos, as each video part is marked multimodally by shots on which the main topics are displayed reinforcing the words of the researcher: "Have a mantra or a 'swing' thought" (Q2). This approach of addressing the viewer directly is manifested recurrently through evaluative rhetorical questions that the researchers ask the viewers while maintaining eye contact with them: "Everybody's doing it, right? You're not doing it? You should be doing it. You've been told you should be doing it. Storytelling with data is the big thing" (Q1). Including the viewers in an imaginary dialogue through such rhetorical questions and advocating evaluations that complement the eye contact in the incipient phases of the knowledge-building processes succeeds in minimizing multimodally the distance between researchers and viewers. In this way, the trustworthiness of the arguments presented is also reinforced. Multimodal animations including (handwritten) words, drawings and charts can complement researchers' voice-over explanations and evaluations related to the core knowledge that has to be provided. Evaluative utterances such as "It's really that simple" (Q1) both summarize and reinforce the preceding verbal explanations and the multimodal animations displayed on the screen, implying that the viewers are expected to participate in the proposed knowledge-building processes. The peripheral knowledge-building processes that are multimodally carried out in this genre while the researchers maintain eye contact with viewers include: the researcher's name and the name of their book superimposed on the screen, references to well-known popular culture characters such as Charlie Brown and Lucy (Q1), examples from the viewers' probable experience or the researchers' personal experience (Q2), and the researchers' confessions about their presenting issues, as in "OK, I'm going to spare you most of my sketching because it's too messy and chaotic it probably would just give you a headache" (Q1). Such evaluations of research work are uttered while the researcher is present only in voice-over. The multimodal knowledge-enhancement processes include rare processes of evident enhancement of knowledge. A single reference to other researchers' works can be mentioned: "And so, one of my favorite techniques comes from a Western M.D. called Dr. Andrew Weil" (Q2). However, the apparent enhancement of knowledge is present in diverse ways. For example, the main words uttered by researchers are dynamically superimposed on their close-up images reinforcing visually the main ideas presented verbally by the researchers. For example, in Q2: "Find the 'magic pause' between stimulus and the behavior it triggers" (see Figure 1).

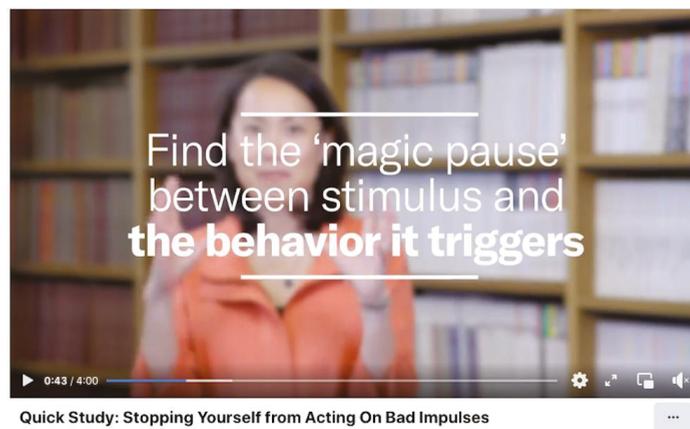


Figure 1. The researcher explaining while her words are superimposed on screen in Q2.

Nothing new is added through such multimodal reinforcement, but the chances that the viewers would accept and/or remember the proposed arguments are higher. Images replicating visually the researchers' voice-over narration have a similar role. Furthermore, information about the researchers' names and their books' names, as well as the videos' creators, is visually repeated.

4.1.2. Tips and Ideas Genre

The video T1 is linked to an issue from the so-called 'Big Issues Series' with the title 'AI, for real'. These are special issues focusing upon different topics. The issue to which the video belongs consists of eight contributions: six written articles, one interview in front of an audience (around one hour), and the video. This video thus really stands alone; it is not based upon any written product. The video (8.55 min) shows in some detail how each of two people with different cooking experience develops a new recipe and cooks the meal with guidance from the IBM Watson computer, which uses AI. Whereas the accompanying text for the other videos studied here contains links to a specific article or book, this video is linked to the whole issue with its eight contributions. In Bucher's terms, the video belongs to the narrative type, as it tells the stories of two different people in order to demonstrate the potential and workings of AI in a kitchen setting.

The T2 video is related to a Harvard Review Press book [24]. It is a book that presents a general strategy for managing companies and their change and development over time, the so-called Three Box Solution. The video is an interview with the author of the book, in which central parts of the book are presented. The basic logic of the book is preserved in the interview, but the order is not kept fully. However, the video is a resume of the book's presentation of the strategy. Due to the limited space (the book has 240 pages, the video spans 10.53 min) the number of examples and the level of detail in the description of the elements is higher in the book than in the video. For example, the topic of a whole chapter (ch. 5) is not taken up in the interview, and the interview only uses one of the examples around which the book is built. In Bucher's terms, it is an expert video, because the author is here at the centre of the video as interview partner, and we are told some details about him. This distinguishes the video from the two videos Q1 and Q2, where the experts are present, but only the presented subject is the topic of the video.

The Tips & Ideas genre is more diverse in terms of the knowledge-building processes that are performed. The videos selected that have been analysed employ quite different ways of conveying knowledge. For example, in T2, the multimodal knowledge expansion is mainly realized through the interviewer's questions and the researcher's answers uttered while maintaining eye contact with each other in close-up shots: "How can we start to solve this problem?" (see Figure 2).



Figure 2. Interaction between researcher and interviewer in T2.

In the case of T1, the researcher is also visible on the screen, but the explanations are given while maintaining eye contact with an invisible interviewer: “Creativity, discovery, getting recommendations, advice, that’s all things that you can apply to your own industry whether it’s retail, finance, travel and so on”. Furthermore, if in T2 the core knowledge-building processes are also manifested through only one shot without the researcher and the interviewer on screen (a still shot of three red boxes with superimposed text on them: “Manage the present”, “Selectively abandon the past” and “Create the future”), in T1 these processes are accomplished through shots of people working with an IBM Watson computer system or with food; these shots are complemented by the researcher’s voice-over. The peripheral knowledge-building processes are strongly manifested in T2, as the researcher and the interviewer make references to the researcher’s work: “While the book is new, this is an idea that you’ve been working with for a very long time”. In both videos, references to the participants’ domains of expertise are also included. As a means of performing evident knowledge-enhancement processes, T2 employs references both to other researchers (“This is something that C.D. Prahalad introduced”) and to illustrative examples (“Take, for instance, an example of Microsoft”). Such references are absent in T1, but these processes are still performed through various shots of the experiment’s participants while working with food and explaining what they do: “So, Watson left it up to me to be creative with my plating”. The personal evaluations of the experiment (and of their biases) are also embedded in their staged dialogue with the computer or in the researcher’s dialogue with them. The processes of apparent enhancement of knowledge are manifested through repetitions of the name of the video, the researcher’s name and the name of the book on the first and the last shot of the video.

4.1.3. Explainer Genre

The E1 explainer is related to an article in the *Harvard Business Review* [25]. The article is mentioned and linked to in the accompanying description. In the video, the relation to an article is indicated, but only the authors, not the title of the article (which is different from the title of the video), are mentioned. The video is a summary of the article. It has the same structure and follows the same line of argumentation, but is less detailed in its presentation, and one supporting study is mentioned in the article but not in the video. Hence, this video is very closely related to the underlying article. The format is that of animated drawings supporting the verbal presentation. Based on Bucher’s typology, this is therefore an animated video.

The E2 explainer, which also uses animated drawings supporting the verbal presentation, is related to a book published by Harvard University Press [26]. The book is mentioned in the short description accompanying the video and in a written text at the end of the video. It is not mentioned at any earlier point in the video. The content of the video is more basic and definition-oriented than the book, which has a clear target in business managers that should be working more with big data. The video explains what is understood by ‘big data’, what the analytic challenge is, what types of analytics exist, and presents a model for working with data analytics in a business context. Hence, the video stands alone from a content point of view and may function as a supplier of background knowledge relevant for understanding the book. In Bucher’s terms, it is also an animated video.

In the case of the Explainer genre, the multimodal knowledge-expansion in relation to the short descriptions accompanying the videos is accomplished through both core and peripheral knowledge-building processes. However, in contrast with the other two genres, the researchers are no longer present on the screen. Only multimodal animations including words, numbers, abstract figures and music complement a voice-over’s detailed explanations and evaluations: “Having only one woman or minority in a pool of finalists highlights how different he or she is from the norm and decision makers often unconsciously associate difference with risk, or even incompetence” (E1). The expected complementation between the employed semiotic modes is weak and this influences the expected unfolding of the knowledge-building processes. The dynamic character of the multimodal animations

with statistical information, abstract images, words displayed in movement on the screen and rapid voice-over narration hinders a smooth unfolding of such processes. Although rhetorical questions addressing the viewers (“And how can they help your business?”) and references to viewers’ probable experience (“We’ve all heard the buzzwords”) still accompany some shots, as in these examples from E2, the distance between the researchers and the viewers is not minimized, as it is in the case of the two other genres. Processes of evident enhancement of knowledge are not part of this genre’s communication of knowledge. The multimodal interaction does not provide knowledge not already presented in the verbal mode. Nevertheless, as in the case of the other two genres, processes of apparent enhancement of knowledge can be encountered: the researchers’ and their *HBR* article’s names displayed on the first and last shot of the video, and the repetition of certain words across semiotic modes.

4.2. Multimodal Knowledge Communication in Social Media Comments

This analysis is based upon the type of tables exemplified as Table 2 above.

Before starting this analysis, we assumed that, being a social network that has the affordances for knowledge sharing, Facebook would provide a rich array of comments related to the videos posted by *HBR*. However, the social media engagement manifested on this platform in the specific context of the *HBR* wall proved to be much more restricted than expected. As a consequence, the types of multimodal knowledge-building processes existing in the comments are also less diverse than predicted because user commentaries that actually evaluate the knowledge provided or/and contribute to communicating and co-constructing new knowledge are quite scarce. Furthermore, the comments are similar in relation to all the *HBR* videos analysed, meaning that the generic specificities and the types highlighted above have not influenced the users’ behaviour.

Due to the users’ behaviour in relation to the *HBR* videos analysed, processes of knowledge expansion are absent. Neither core nor peripheral knowledge-building processes are manifested in the users’ comments. Nevertheless, knowledge-enhancement processes are represented especially through apparent enhancement of knowledge. The manifestations of evident enhancement of knowledge are rather sporadic and appear only in the comments to some of the videos. These manifestations differ from what was encountered in the videos because the knowledge provided is not new knowledge related to other researchers’ work, but to the users’ own readings: “Some time back I read a book with similar approach and great concept around project management ‘A Recipe Book For Practical Project Management’” (T2). Evident enhancement of knowledge is also performed through what Bucher above calls epistemic review, i.e., evaluative reflections on the validity of the single utterances, not the whole video: “I think that the myopia of failing to hire women and minorities for C-suite positions fall upon the white men’s inability to supersede their biases” (E1). Such comments may not only nuance the knowledge provided in the videos, but also problematize it: “I think using tech as an example for this model can be complicated, because it is a gamble on what the future market demands today and the loyalty of the brand followers. IBM and HP also “missed” these innovations that the speaker mentioned” (T2). It is worth mentioning that only one comment is characterized by harsh critique in the form of what Bucher calls an evaluative comment: “It’s funny how seriously they are spewing bullshit good comedy” (T1).

The main manifestations of apparent enhancement of knowledge appear in the comments reviewing the validity or assessing the general value of the videos’ content with different degrees of nuancing and enthusiasm expressed through various evaluative adjectives or/and the number of exclamation marks: “This is fundamental for progress at all levels, be it organizational or individual (for a particular person), the concept is brilliantly explained” (T2); “Very interesting research” (E1); “That’s totally right!!!!” (Q1). The users’ engagement with the videos’ content is also manifested through processes of apparent enhancement of knowledge that only implicitly acknowledge this engagement by involving friends or acquaintances. Such involvement is achieved just through naming persons who,

presumably, should or could be interested in the videos; only rarely, these persons are also encouraged imperatively: “D check this out” (Q1). In Bucher’s typology of comments, these comments can be seen as mainly working on personal relations.

Unexpectedly, the multimodal manifestations of knowledge-building processes in the users’ comments are also rare. Some of the epistemic or evaluative comments are accompanied by emojis, or emojis can also appear unaccompanied by verbal comments. In a few cases, the comments are accompanied by links to other social media platforms, websites or short videos that are not topic-related to the *HBR* video: “If you want to create a beautiful logo, banner, visiting card, then visit this site <http://www.fiverr.com> . . . ” (E2); “NEED QUICK CASH? emojis APPLY BELOW [sic!] emoji link” (Q1). Such comments may not be accompanied by any kind of multimodal material, but they are more detailed and include more advertising imperatives: “Live longer and extend your youth with R2. Resets up to 50 Youth Gene Clusters to turn back the clock and reverse aging for a maximum of 20 years. PM me for more details” (E1). Apart from this scarce manifestation of multimodal communication, it has also been observed that the platform’s inherent affordances for discussions among the various users or between users and *HBR* are rarely used, although some of the comments show a real need for interaction by addressing questions: “What is a thirty-year bubble?” (Q1). These questions are never answered.

Lastly, it should be mentioned that the knowledge-building processes may be also hindered by the fact that the comments appear in various languages, and some of those that appear in English seem to be translated automatically from another language or are posted by non-native speakers: “Every information will be able to build as big data for analysis with marketing. Those can be occurrence and expand about chance for brand new business” (E1).

5. Discussion and Conclusions

As shown above, the multimodal knowledge expansion and enhancement building processes that have been detected in the Quick Study genre in relation to the short descriptions accompanying the videos are characterized not only by the researchers’ endeavours to provide accessible explanations, but also by their strategies to minimize the distance between themselves and the possible viewers. Imperatives, rhetorical questions, confessions, and eye contact are the main strategies through which the researchers succeed in accomplishing this. While in the Quick Study genre these strategies ensure a strong implicit presence and involvement of the viewer, in the Tips & Ideas genre these strategies are absent, and the viewer is relegated to a mere onlooker role. A similar role is also given to viewers in the Explainer genre, but not to the same degree, as some rhetorical questions addressing the viewers still appear in the videos belonging to this genre.

The unexpected results of our analytical work performed on the FB users’ comments have revealed that the users’ engagement with this social medial platform is characterized by a scarcity of knowledge-building processes. Although some of the videos analysed have been viewed by up to 160,000 users and have received up to 3300 reactions, the number of comments is much lower and, as explained above, only processes of apparent enhancement of knowledge characterize them. This scarcity of knowledge-building processes might be motivated by the fact that the FB platform’s affordances for dialogue and networking are not exploited by *HBR*, either. *HBR* does not invite dialogical contributions, and other users in all generality do not engage in dialogue either with *HBR* or with other users. *HBR* share their videos on their FB platform and some users comment on those videos individually. Thus, although “the content interactivity” is manifested through the users’ comments to the videos’ content, the “human interactivity” [6] (p. 3) is absent, as no “knowledge conversation” [29] (p. 38) takes place, influencing in this way the knowledge-building processes that can appear in this context.

Here, it may be relevant to look in more detail at the context of the videos. Although the six videos we have investigated cover all of the types of science-oriented YouTube videos suggested by Bucher, they do not generate much debate, especially not on the con-

tent (Epistemic assessment), which is by far the most frequent type of comments in Bucher's corpus. In this context, it is important that, although the videos may all be watched as independent, stand-alone scientific contributions, with a varying content relation between video and underlying article, book, or *HBR* issue, all the videos are indicated as introductions, as teasers for the real thing ("for more, see . . . "). A good hypothesis is that viewers do not engage with the videos, even where the actual researcher/author is present in the video and engaging with the users, because they see the videos more as advertisements and less as actual stand-alone attempts to convey knowledge, as in Bucher's science videos.

As such, our study's results related to knowledge-building processes facilitated by the social media engagement affordances confirms the claims of other researchers:

"Social media, such as WhatsApp, Facebook, YouTube, and other portals, may promote the transition beyond knowledge sharing to co-construction and informal learning, since they enable users to discuss the shared content. Yet critical evaluation, refinement, or improvement of ideas shared on such sites is not guaranteed." [30] (p. 4).

To conclude, in spite of the fact that we have focused on a limited number of genres, in this study we provide systematic explanations of a conceptual framework and of qualitative research processes (i.e., the multimodal strategies of detailed transcribing and analysing) that can be replicated in other contexts. By taking this methodological approach, we have been able to go beyond textual analysis and have clarified how we can investigate both the roles of individual semiotic modes and their meaning-making interplay when the knowledge of academics is disseminated to professionals and other non-academic communicative partners.

Building on our approach and the present empirical results, we encourage future research endeavours not only to employ this framework but also to improve it by exploring additional genres, so that the rapid development of hybrid knowledge communication can be continuously understood and documented.

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Article

Dialogicity in Individual and Institutional Scientific Blogs

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Abstract: The paper focuses on variation across institutional and individual scientific blogs, i.e., blogs that are managed by journals, magazines or associations involved in the dissemination of scientific information and blogs that are managed by individual researchers. Using comparable corpora of posts from different scientific disciplines, look in particular at markers of dialogicity, i.e., the representation of participants (markers of self-reference, reader-reference, as well as representation of the scientific community and markers of attribution), markers of communicative action (organizational units and metastatements), and evaluative dialogue (evaluative lexis and dialogic contraction or expansion). Concordance analysis of keywords and key-phrases (as calculated by Wordsmith Tools 8.0) shows that blogs managed by individual scientists emphasize personal voice and interpersonal elements, while institutional blogs are comparatively more informational. Dialogicity markers are shown to contribute to defining how bloggers manage subjective and intersubjective positioning and construct their credibility, thus defining the nature of their relation to the audience and ultimately the functions of blogging.

Keywords: blog posts; dialogicity; identity; personal vs. institutional blogs

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1. Introduction

Blogs have long attracted the attention of academic institutions for their promotional and outreach potential in the extended participatory framework of the Web [1]. As they are regularly updated web spaces with posts linked to relevant material and open to readers' comments (e.g., [2] (pp. 2–7)), blogs can be seen as “a designed space with many potential uses” [3] (p. 29) and virtual arenas where information is produced, shared and commented on evaluatively. They are characterized by a rather loose set of communicative purposes—typically dissemination of information, presenting personal attitudes, and networking [4,5]. Their peculiar combination of self-expression and knowledge sharing [6] has made them ideal places for identity and relationship management [4,7]. They have variable structures [8,9], but they are recognizedly “highly social” [10] (p. 435) and they are seen as places for “you to have your say” [11] (p. 99), often dominated by personal experiences and opinions rather than facts [12–14].

In a world qualified by a wide range of social media environments, blogs are certainly not the only—or even the main—digital tool available for scholars. Real-time collaborative writing tools and social media have been shown to influence scholarly writing deeply, e.g., [15,16]. Vlogs, podcasts and networking sites have greatly increased the possibilities of scholarly communication, thus often leading to awareness of a complex digital media ecology in scientific communication [17], where traditional and new media co-exist and build on each other. There has also been intense debate on the diminished status of blogs in many fields, especially in online debates [18,19], pointing at the need for blogs to reposition themselves in the context of a wide range of platforms. In political communication, for example, politicians have shown a clear preference for keeping in touch with the wider public through other social media (e.g., Twitter), but blogging remains a key tool of “citizen journalism” [20]. In the world of research and academia, blogs continue to be popular, even if often ephemerally so. There has in fact been a steady increase of research

publications in blogs [21]. There may be different reasons for this. For one thing, blogs offer greater opportunity to engage with more complex forms of textuality and intertextuality than other social media; they also offer opportunities for “slow thinking” (less structured than traditional publications but more open to the development of an argument) [22], and they are more open to an undefined community, thus contributing to personal and institutional identity management [23].

Scholars use blogs to construct their identity as members of a disciplinary group, to highlight their authority and expertise and to enhance their visibility [13] (p. 162), [24]. The effectiveness of the materials posted may influence the scholar’s reputation, and this in turn may emphasize the credibility of the information provided [25]. Blogs can then be seen as key resources providing evidence of the authority and expertise of scholars, constructing their visibility and identity as members of a discipline [13] (p. 162), with “personal knowledge” [12] (pp. 518–519) increasing the blogger’s visibility, reputation and trust. Research blogs have attracted particular attention for their potential in developing as well as disseminating research [12,26–28]. They offer an opportunity to combine research and popularization [29], to present and discuss work in progress, to receive feedback from peers and at the same time interact with the general public [10] (p. 432), as “unknown, heterogeneous, and varied audiences may participate in co-constructing research debates” [30] (pp. 30–31). The format lends itself well to the processes of making scientific information accessible to general audiences: information is re-contextualized by means of “mediation, re-expression or translation of scientific issues into contexts that mean something to audiences” [31] (p. 88). It should be noted, however, that when interviewed regarding reasons for blogging, scholars have long shown [32] that they see blogging as a form of “common room” where they can discuss academic work conditions and policy contexts, share information and provide advice, as well as a form of “open access” resource, where they can get to print early and share ideas. This means that most academics blog for their peers rather than for the general public.

The format of blogs clearly offers great opportunities for the study of interactivity and writer/reader interaction [33]. Attention has been paid, on the one hand, to how interactive affordances open debate to patterns of agreement and disagreement [34] and even open conflict [14], and on the other to increased possibilities for collaborative research, interaction and feedback [30]. Discussions on blogs can add to bodies of knowledge and can contribute to building a reputation, but the “community of blogging practice” [4] is bound to include both experts and lay spectators or commenters, and it is difficult to say whether the intended audience of academic blogging is the collective witness of experimental science or the intended/universal audience of argumentative discourse [30]. The difference between scholarly communication and public communication is less marked (if not collapsed) on the web [35], as there is no actual control on the audience. Blogs can be seen as hybrid genres situated between academic and journalistic writing [36]. The possibility to engage in conversation and foster a sense of community is counterbalanced by the difficulty of predicting ideal readers and of establishing room for negotiations and predictions [37], in conditions of intentional or unintentional context collapse [38].

Academic bloggers engage with their readers in different ways; as shown by Zou and Hyland [39], for example, blogs in the social sciences tend to use more reader mentions, directives and questions, while life sciences and physical sciences blogs rely more on the authority of the writer and on shared understanding. Interactivity in the form of participant mentions is also shown to be very high in the comments when compared to the posts [40]. On the other hand, even if blogs somehow blur the distinction between science and public science, between internal communication and external communication, interaction among commenters often only takes the form of “interwoven polylogues” [41,42], i.e., multi-party conversations bringing together different audiences, which often alternate but do not always mingle. Participants with different backgrounds are thus allowed different ranges of verbal action and the interests of different types of participants seem to be dealt with on separate planes [43]; interwoven polylogues engage participants in parallel

conversations, some of which are more clearly oriented to just sharing views, while others aim at knowledge dissemination and knowledge construction proper [44].

Authorship is also extremely variable in research blogs, as they are produced in a variety of different contexts by a wide range of authors, from researchers to professional science journalists, and their role is not always clearly identifiable. The present paper aims to focus on scholarly bloggers and to explore variation in authorial identity across institutional and individual scientific blogs, i.e., collective, multi-authored blogs that are managed by journals, magazines or associations involved in the dissemination of scientific information and blogs that are managed by individual researchers.

Using comparable corpora of blog posts from different areas in science, I look in particular at markers of dialogicity, i.e., markers of dialogic interaction between the writer and the reader. I look at this from three points of view [45]: the representation of participants, of communicative action and of the evaluative dialogue between writer and reader. The representation of participants can be analysed by looking at markers of self-reference or reader-reference such as first- and second-person pronouns, as well as through references to the discourse of the scientific community. The representation of communicative action can be studied by looking at units and patterns that are meant to structure discourse, such as connectors and discourse markers. The evaluative dimension of writer–reader dialogue can be seen through the evaluative lexis typically used in praise and criticism and the way this opens or restricts the space for negotiation of meaning on the part of the reader.

The expectation, actually confirmed by the data, is that blogs managed by individual scientists emphasize personal voice and interpersonal elements, while multi-authored institutional blogs are comparatively more informational. The questions that guide the analysis are questions regarding the nature of authorial “voice” in the two contexts, where individual blogs may be thought to be more focused on a single personality and reflect more their individual identity, while institutional blogs have posts written by many different authors and may therefore be taken to involve the individual identity of the blogger together with the collective identity of the organization itself. Are there differences in the way scholars manifest interaction with their readers in the two contexts? Are these differences mostly related to well-established forms of self-mention? Or do other features play a role too? And if so, what role?

The next section introduces the two corpora of blog posts used and the types of analysis adopted. Section 3 presents the results of the comparison and then looks at the language resources that characterize the posts of the two main types of blogs in light of the dialogic principle, looking at the single communicative action of the posts as dialogic and dependent on the communicative context. The conclusions summarize the discussion and look at the implications of the study.

2. Materials and Methods

The study is based on the Science Blogs Corpus compiled by Freddi (see [40] for a full presentation of the corpus). The corpus comprises posts and comments from a wide range of scientific disciplines (physics and astronomy, medicine and health, biology and life sciences, earth and environmental sciences) and is divided into two main sub-corpora:

- Individual blogs managed by “individual scientists who, despite having an institutional and academic affiliation, maintain a personal webpage where they blog freely about scientific issues of their own interest”, including researchers of different seniority and institutional affiliations, all based in the US;
- Multi-authored institutional blogs that are “representative either of science magazines and newspapers [...] or of educational institutions, research centres and scientific journals running their own blogging networks” [40] (pp. 12–13).

Four blogs were chosen for each category. Selection criteria were based on top-ranking position, disciplinary area and degree of interactivity [40]. The distinction between the two sub-corpora is obviously more heuristic than ontological, as there is understandably a whole cline of possibilities in terms of authorial individuality of the blog. Some contextual

information on the two sets of blogs may help understand the balance of individual and collective identities constituting the voice of each blogger.

The four individual blogs are managed by four academics characterized by different interests, different degrees of seniority and different forms of autonomy: two are fully independent individual blogs, whereas the other two are part of a network of blogs. “Skulls in the Stars” is managed by a blogger who signs with a pseudonym (Dr. Skyskull), but is also identified as associate professor of physics, specializing in optical science, at UNC Charlotte (US). “NeuroLogica Blog” is clearly attributed to Dr. Steven Novella, clinical neurologist, assistant professor at Yale University School of Medicine, also active as producer of a popular weekly science podcast, *The Skeptics’ Guide to the Universe*, as well as in many other public organizations. On the other hand, “Genomics, Medicine and Pseudoscience”, while authored exclusively by Steven Salzberg, Bloomberg Distinguished Professor at Johns Hopkins School of Medicine, is part of an independent network of science blogs called “Field of Science”; as explicitly stated by the website “although part of a network, bloggers on Field of Science exercise complete editorial freedom and own their blogs and content”¹. Similarly, “Mountain Beltway”—authored by Callan Bentley, Assistant Professor of Geology at Piedmont Virginia Community College in Charlottesville, Virginia—is also part of a community of earth and space science blogs, hosted by the American Geophysical Union.

The four blogs that are classified as institutional are multi-authored scholarly blogs representing different types of organizations and different editorial policies. On the one hand we have the official blogs of PLOS (Public Library of Science) and Physics Buzz, the official blog of the American Physics Society. These are academic blogs hosting a number of diverse bloggers active in the world of research; both have their specific editorial policies—in favour of open science and open data for PLOS, advancing and diffusing the knowledge of physics for the benefit of humanity for APS. On the other hand, there are two blogs associated with two traditional popular science magazines: “Discover Magazine” and “Science News”. These blogs are typically subdivided into sections covering different areas of science and host a high number of different bloggers, coming from the world of scientific research but often also pursuing a career in scientific journalism.

The present analysis is based on comparing the posts only, for a total of approximately 791 posts and 650,000 words. The collection covers a five-year span of the eight blogs, including approximately two posts per month between March 2014 and March 2019. The data are presented in Table 1.

Table 1. Composition of the blog post subcorpora.

Individual Blogs			Institutional Blogs		
Title	Word Count	No. Posts	Title	Word Count	No. Posts
Genomics, Medicine and Pseudoscience	93,068	122	Discover Magazine Blog	83,714	120
Mountain Beltway	86,819	199	Physics Buzz	94,858	91
Neuro Logica Blog	45,196	40	PLOS	93,826	89
Skulls in the Stars	91,585	52	Science News	74,585	82
Subtotal	316,668	413	Subtotal	346,983	382

The table shows that disciplinary representativeness is admittedly limited and not equally balanced across corpora and blogs, as the choice of posts was also determined by temporal sequence and appropriate availability of comments (for purposes that fall outside the scope of this study). This suggests focusing the analysis only on elements that might not be strictly related to disciplinary content, as comparison might otherwise be skewed.

The post components of the corpus were first analysed using Wordsmith Tools 8.0 [42]. The quantitative study started with an overview of keywords and key-phrases, looking in particular at 4-word clusters, i.e., strings of contiguous word forms. The software defines keywords as word forms with frequencies that are higher or lower than an expected standard in statistically significant ways. Significant differences between the two corpora were explored by contrasting the two sets of posts. Contrasting the wordlists of personal and institutional blogs highlights the distinctive features of each corpus, i.e., those that vary in statistically significant ways. Examples are identified by abbreviation of the blog title and date of the post.

Attention was paid to both positive keywords (those that are significantly more frequent in the first corpus) and negative keywords (those that are significantly less frequent and therefore more frequent in the reference corpus). Frequency lists of 4-word clusters were also explored, on the assumption that phraseology is often a good indicator of typical uses and in order to be able to compare the results with those of Freddi [40], whose study focuses on the difference between posts and comments by studying keywords and 4-g, i.e., 4-word clusters.

Concordances were then studied to identify the effective role played by the word forms in context and the discourse function of the units they belonged to. This also meant paying attention to syntactic patterns and to collocation, colligation and “semantic preference”, i.e., the tendency of a word form to co-occur with specific word forms, specific functional units and sets of lexical elements characterized by specific semantic traits [45].

The quantitative analysis focused on aspects that could be related to the dialogicity of posts. Following guidelines already applied to blogs [44], I looked at three dialogic perspectives: participant-oriented features, action-oriented features and evaluative dialogue.

From a participant-oriented perspective, the relevant dialogic features are those that identify the blogger and the community of writers/posters/readers evoked. This means paying particular attention not only to forms of self-reference and references to the reader (such as first- and second-person pronouns) (see for example [46] on self-mention and reader engagement as elements of metadiscourse), but also to the representation of the scholarly community and forms of attribution.

From an action-oriented perspective, the relevant features will be both those that contribute to interaction-oriented and text-oriented organizational units [47]: expressions that are used to manage writer–reader interaction (e.g., “as shown above”) and words or phrases that manifest textual coherence, such as connectors and metatextual statements.

Finally, the perspective interested in evaluative dialogue (partly overlapping with the other two) will focus on how claims, arguments and attributions are assessed in both epistemic and attitudinal terms [48,49], and how they position the reader in terms of acknowledging the need to negotiate topics and positions (dialogic expansion) or restricting the scope for negotiation (dialogic contraction) [50] (p. 102). See Figure 1 for an overview.

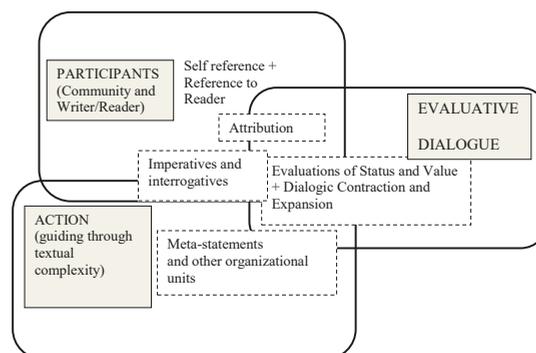


Figure 1. Elements of dialogicity [44] (p. 146).

The results of the analysis are presented by dividing the keywords—identified by the software on a purely statistical basis—according to these three dialogic perspectives. It should be noted that keywords or key-phrases can often have more than one function and therefore cut across perspectives. A word form like “see”, for example, could be used both to represent debate in a participant-oriented perspective (“they see this as”) and to guide the reader (“See figure”) in an action-oriented perspective. The various forms are presented under the heading that proved to be dominant in a preliminary concordance analysis.

3. Results and Discussion

3.1. Participant-Oriented Dialogicity

A study of positive and negative keywords and key-clusters provides a view of similarities and differences between the two sets of posts. Tables 2 and 3 below report selected keywords that were found to play a major role in participant-related dialogicity, such as pronouns referring to the writer and the reader or expressions referring to the discourse community. The discourse community is often referred to by identifying specific scientists, but also by plural and collective nouns referring to the community in general or to specific texts (in their paper or digital versions), as blog posts often take their origin from a text published in a scientific journal, a scientific report, another blog or a website devoted to relevant issues. The table ignores the specific names of authors cited, personal pronouns used to refer to them and references to specific disciplines (which may simply depend on an imbalance of disciplines in the two corpora); it includes, however, other general nominal elements that are used in the corpus to refer to the community and to relevant textual formats. These are listed using BIC (Bayesian information criterion) as the ordering principle, with positive keywords in descending order and negative keywords in ascending order. Frequencies are normalized per ten thousand words (pttw). Figures are rounded down (except for BIC data, where decimals may determine the order).

Table 2. Participant-related keywords: individual vs. institutional blog posts.

Keyword	Individual Posts Frequency	Pttw	No. Texts (Individual Posts)	Institutional Posts Frequency	Pttw	BIC
<i>I</i>	2663	84	374	1073	31	838.52
<i>Book</i>	307	9	88	34	1	264.45
<i>Here</i>	557	17	239	174	0	235.24
<i>My</i>	631	19	234	275	8	165.78
<i>Title</i>	142	4	25	6	0	154.64
<i>Me</i>	366	11	183	115	3	148.92
<i>Books</i>	76	2	44	12	0	44.67
<i>FDA</i>	97	3	23	23	0	42.88
<i>Post</i>	173	5	92	71	2	40.68
<i>Doctor</i>	72	2	35	13	0	37.42
<i>Am/m</i>	120	4	80	45	1	29.17
<i>Article</i>	121	4	62	46	1	28.91
<i>College</i>	94	3	48	30	1	27.54
<i>Let's</i>	53	2	40	9	0	25.43
<i>NIH</i>	91	3	23	32	1	21.89
<i>Blog</i>	87	3	54	30	1	21.18
<i>Website</i>	52	2	34	11	0	19.55
<i>Readers</i>	39	1	34	10	0	7.75
<i>Writing</i>	69	2	52	29	1	7.36
<i>Posts</i>	43	1	26	13	0	6.46
<i>Doctors</i>	54	2	25	22	1	3.65
<i>Fiction</i>	51	2	22	21	1	2.44

Table 2. Cont.

Keyword	Individual Posts Frequency	Pttw	No. Texts (Individual Posts)	Institutional Posts Frequency	Pttw	BIC
Neg. Kws						
<i>Model</i>	53	2	33	116	3	5.08
<i>Findings</i>	27	1	21	91	3	14.26
<i>University</i>	179	6	85	327	9	17.70
<i>Colleagues</i>	67	2	50	183	5	32.16
<i>Project</i>	32	1	24	122	3	34.54
<i>Research</i>	285	9	85	546	15	47.24
<i>Scientists</i>	211	7	85	482	14	71.48
<i>Team</i>	44	1	27	255	7	132.08
<i>Researchers</i>	81	3	50	384	11	173.63

Table 3. Institutional vs. individual blog posts: other participant-related keywords.

Keyword	Institutional Posts Frequency	Pttw	No. Texts (Institutional Posts)	Individual Posts Frequency	Pttw	BIC
<i>Researchers</i>	384	11	155	81	3	173.63
<i>NASA</i>	118	3	43	13	0	73.86
<i>Lab</i>	119	3	67	16	0	66.06
<i>Models</i>	72	2	33	15	0	22.02
Neg. Kws						
<i>You</i>	1.116	31	244	1.205	37	3.48
<i>We</i>	1.492	42	290	1.708	53	28.54
<i>Evidence</i>	179	5	93	300	9	29.91

A few other keywords emerge by focusing on institutional blog posts and contrasting them with individual blog posts. These are reported in Table 3.

3.1.1. First- and Second-Person Pronouns

Individual blog posts are thus qualified by more systematic references to the first-person singular: especially “I”, here including also contracted forms such as “I’d/’ll/’m/ve”, but also “my”, “me”, “am/’m”. These certainly make both writer presence and dialogicity more conspicuous, as in the following examples:

- (1) *Several people, including my orthopedic specialist, have suggested that I try injections of hyaluronic acid to treat my knee pain. Many people swear by it, and even though I looked into this two years ago (and rejected it as ineffective), I thought I would look again (GEN_2015-05-18).*
- (2) *In this column over the past few years, I’ve highlighted just a tiny sample of the remarkable advances coming out of the scientific world (GEN_2014-06-16).*
- (3) *How much should we invest in biomedical research? Let me put some numbers on the table (GEN_2014-06-16).*

The extracts above also exemplify important identities of the blogger. An analysis of 200 random concordances from each corpus shows, in fact, that the difference between the two datasets is also qualitative, when considering the semantic reference of personal pronouns and their collocates.

In individual blog posts, the first-person subjects co-occur very frequently with verbs indicating mental or verbal processes. The most common collocates are forms of verbs such as: “think”, “read”, “find”, “know”, “like”, “say”, “write”, “see”, “feel” (including perceptive verbs such as “see”, cognitive verbs such as “know” and emotive verbs such as “like”). In institutional blog posts, the processes referred to are mostly mental—e.g., in order

of frequency: “think”, “know”, “read”, “love”, “find”, “want”, “believe”, “hope”—with an important role of desiderative and emotive verbs together with cognitive verbs.

When looking at the wider context, it is possible to identify the types of self that bloggers construct in their self-mentions. Adapting work carried out in the study of academic writing by Tang and John [51] and Vladimirou [52], we might say that the most prominent identities are:

- the biographical individual self (example 1);
 - the blogger as writer (whether referring to the regular activity of writing as in example 2 or to the ongoing interaction as in example 3);
 - the blogger as pundit, conflating Tang & John’s [51] (pp. 28–29) opinion-holder—sharing “an opinion, view or attitude”—and originator—claiming authority over the main ideas and knowledge claims proposed (example 4 below);
 - the blogger as academic, including both lecturer (5) and researcher (6).
- (4) *All told: I think this is a really, really useful book that discusses really, really important stuff (MB_2019-03-25).*
- (5) *(Old Rag Mountain is a distinctive mountain in the eastern Blue Ridge of Virginia, contained in a little lobe of Shenandoah National Park. It’s a great hike on several levels: [...], which is why I brought a group of four of my Rockies students there last Friday for a training hike (MB_2014-06-16).*
- (6) *I like the general approach suggested in the current paper, which is to do a compatibility analysis. This is essentially what I do in an informal way—to look at all of the data analysis and ask, what kind of world are these data most compatible with? (NEU_2019-03-22).*

References to the biographical self and to the blogger as writer are more evident in the corpus of individual blog posts, where they account for approximately 20% of the occurrences each. The blogger as academic (including both lecturer and researcher) is also around 20%, whereas the pundit dominates with more than 30% of the occurrences being related directly to expressing an opinion.

In institutional blog posts, on the other hand, the representation of the blogger as academic (almost exclusively researcher) remains almost the same, just below 20%, while the self as writer and the self as biographical self are reduced to 12–13% each in favour of the self as pundit (almost 30%). Another noticeable element is that approximately 25% of the occurrences are in reported discourse, while first-person attributed occurrences are almost unnoticeable in individual blogs.

Overall, then, the self as pundit seems to realize the constitutive identity of the blogger across corpora, but the role of the self as writer and the biographical self appears to be more conspicuous in individual blogs, whereas institutional blogs seem to provide much more room for other external voices.

Other pronouns that qualify individual blogs are first-person plural pronouns and second-person “you”. The presence of an inclusive “us” in the imperative form “let’s” guides the reader through the argument and thus belongs more properly to what we might call action-oriented dialogicity (see below); the first-person plural “we”, on the other hand, often occurs in clusters within specific explanatory moves, frequently mixing inclusive “we” with generalized reference:

- (7) *In the Copenhagen interpretation, as we have seen, the behavior of a quantum particle or particles is truly random: [...] we don’t usually measure, or know how to measure, all the variables that decide whether a coin comes up heads or tails (SKU_2017-05-06).*

Finally, while acknowledging the undoubtedly major role of generalized “you” in scientific argument and demonstration, individual blog posts are characterized by a richness of direct addresses to the audience. Here, for example, the audience is invited to write “geopoetry” as an educational activity for geology students:

- (8) *As you’ll see, I wasn’t entirely able to get away from jargon (and in fact, the toothsome flavor of geology words is one of the reasons it’s so fun to write about, as John McPhee has noted), but I did manage to come up with a few new ways of describing geologic actions. See what you*

think. If you write any geopoetry (a phrase popularized by Harry Hess) of your own, I hope you'll post a link to it in the comments below (MB_2016-09-19).

3.1.2. The Scientific Community

If the difference in the use of personal pronouns is hardly surprising, variation in the representation of the interlocutors of the blogger is more interesting. References to texts as repositories of ideas or evidence to be discussed are altogether extremely common: “book(s)”, “titles”, “post(s)”, “article”, “writing”, “evidence”, “blog”, “website” account for a good many references to sources quoted, often evoked also by deictic reference (“this”, “here”):

- (9) *And just last summer, Robert F. Kennedy Jr. published a new book further promoting the long-discredited claim that thimerosal causes autism (GEN_2015-02-01).*
- (10) *For an excellent summary of NCCIH's history, see this short video from Reason TV or my own talk from a 2015 conference, here (GEN_2018-01-08).*

Individual blogs thus do not only give more space to the blogger and great prominence to their biographical self and their academic self interacting with readers, they also highlight the position of bloggers in a constant debate with sources and scholarly production, as members of the discourse community.

Institutional blogs, on the other hand, favour explicit reference to the process of inquiry (“model”, “findings”) and the representation of science as collective work with plural categories (“researchers”, “team”, “scientists”, “colleagues”) or collective nouns (“team”, “NASA”, “FDA”, “lab”, “project”), while they are more limited in the use of “college”, a word often used to identify the educational component of the academic context. The greater frequency of plural or collective categories of researchers contributes to both general reference to the background of the world of science and specific reference to a particular paper or discovery:

- (11) *For decades, researchers had identified gallium nitride as a material that could potentially produce blue light very efficiently, but huge technological problems, which seemed insurmountable at times, stood in the way of a practical consumer device (PHY_2014-10-06).*
- (12) *A team of researchers at the Technical University of Denmark's (DTU) Nanotech and Fotonik departments has innovated a new laser-printing technology that is able to achieve a resolution of 127,000 dots per inch (PHY_2016-01-07).*

Overall, then, institutional blog posts do not only reveal a less personal, more formal representations of science, but also a clearer emphasis on its collaborative nature. The small set of 4-word clusters obtained by contrasting the two corpora confirms the key role played by representatives of the discourse community in institutional blog posts, given the high frequency of “at the university of” (75 occurrences of in 54 texts (2 pttw) vs. 16 occurrences in 15 texts in individual blogs). The expression is mostly used to introduce specific scientists whose research is reported (13), but occasionally also includes a few background generic references (14) and even one first-person report (15):

- (13) *“By the end of the Devonian, there were vertebrates that were quite at home moving around on land,” said Balbus, who is at the University of Oxford in the United Kingdom (PHY_2014-06-30).*
- (14) *In 2013, scientists at the University of St. Andrews made headlines by propelling a tiny sphere to a record-breaking 600 million rpm (revolutions per minute) (PHY_2018-09-10).*
- (15) *Five years later, I worked part-time in a lab at the University of Texas cultivating strains of algae that naturally accumulate oil (PLOS_SB_2015-09-08).*

In terms of participant-related dialogicity, then, the analysis of keywords and key-phrases has shown that institutional blogs tend to favour patterns of attribution, with the blogger reporting scientific discoveries and debates and third-person researchers occupying centre stage. Individual blogs, on the other hand, tend to favour reference to the direct participants, thus highlighting the identity of the blogger in terms of their biographical and academic self.

3.1.3. The Representation of Discourse within the Community

Tables 4 and 5 provide a list of the keywords that qualify the verbal processes in the debate the post is contributing to (e.g., “claim”). As previously stated, Table 4 lists all the elements obtained, focusing on individual posts and using institutionalized blog posts as reference corpus, while Table 5 adds a few other keywords obtained focusing on institutional blog posts and using blog posts for reference. As already noted, these reflexive elements can often cut across perspectives. Forms of the verb “note”, for example, can be seen to serve very different functions: they can be used to describe what reported authors do (“he noted”), to attract the reader’s attention with an imperative (“note that”), and to structure the development of the text through expressions such as “as noted previously”, “I also noted”, “it should be noted”, etc. The various verbal forms (and their nominalizations) are presented under the heading that proved to be dominant in a concordance analysis.

Table 4. Attribution and the representation of discourse in individual blogs.

Keywords	Individual Posts Frequency	Pttw	Texts	Institutional Posts Frequency	Pttw	BIC
<i>Claims</i>	144	4	58	14	0	123.60
<i>Claim</i>	99	3	61	19	1	53.78
<i>Written</i>	91	3	68	24	0	34.74
<i>Wrote</i>	96	3	65	31	0	27.86
<i>Claimed</i>	26	1	24	1	0	17.86
<i>Claiming</i>	34	1	29	4	0	16.58
<i>Argued</i>	32	1	19	4	0	14.07
<i>Noted</i>	65	2	43	23	1	11.60
<i>Stories</i>	61	2	34	22	1	9.49
<i>Writing</i>	69	2	52	29	0	7.36
<i>Recommend</i>	30	1	28	6	0	6.37
<i>Write</i>	64	2	42	29	1	3.57
Neg. Kws						
<i>Explains</i>	27	1	27	73	2	4.44
<i>Response</i>	36	1	28	103	3	14.26
<i>Said</i>	99	3	73	307	9	79.70
<i>Says</i>	62	2	42	482	14	316.47

Table 5. Institutional vs. individual blog posts: other elements.

	Institutional Posts Frequency	Pttw	Texts	Individual Posts Frequency	Pttw	BIC
<i>Responses</i>	37	1	22	4	0	14.18
<i>Studying</i>	57	2	51	15	0	8.90
Neg. Kws						
<i>Story</i>	86	2	54	155	5	13.63
<i>Notes</i>	107	3	46	13	0	62.03

In the representation of verbal action, verbal forms such as “written”, “wrote”, “writing” and “write” typically describe the activity of the blogger and the academic community:

- (16) *For years, scientists (including me) have warned that the anti-vaccination movement was going to cause epidemics of disease. Two years ago I wrote that the anti-vaccine movement had caused the worst whooping cough epidemic in 70 years. And now it’s happening with measles (GEN_2015-02-01).*

What is most interesting in individual blogs, however, is that the representation of academic debates often refers to their argumentative nature and to patterns of claiming and counterclaiming. The process is represented as one of noting (“notes”) but above all claiming and arguing (“claim/s/ed/ing”, “argument/s”) (example 17) or even recommending

(“recommend”). Another important dimension mentioned explicitly is that of storytelling; mention of “stories” is actually quite common in reviews and references to fake news and conspiracy theories (examples 18 and 19):

- (17) *After the lawsuit, Airborne modified their packaging, which now claims only that it “helps support your immune system.” This is one of those vague claims that supplement makers love, because it doesn’t really mean anything (GEN_2014-11-17).*
- (18) *The most dramatic stories occur in the first 2/3rds of the book, which cover World War II and then the initial and dangerous tests of hypersonic rocket aircraft (SKU_2016-08-16).*
- (19) *Stories take on a life of their own. That is the origin of urban legends, myths, and even religion. A good narrative feeds on itself and can be self-sustaining. It evolves and adapts and finds fertile ground in most human hosts (unless they have been inoculated with a sufficient dedication to facts and logic) (NEU_2016-11-15).*

Institutional discourse, on the other hand, prefers more neutral representations of verbal processes, mostly characterized by verbs of locution such as “say” and “note” (20), or references to topic-setting illocutionary functions such as ‘explaining’ and ‘studying’. These references to verbal processes often make up long chains of representations (21) where the actual reporting is mostly realized in non-interpretative terms:

- (20) *“What we see in the great apes, and in corvids [the family of birds that includes crows], and in dolphins, and in elephants, is the social complexity in their lives,” says Andrews. As an example, she cites the grieving behavior of elephants following the death of a relative: Elephants “will go back year after year and caress the bones of dead ancestors,” she says, and notes that dolphins and chimpanzees display a similar behavior (DISC_TC_2014-12-05).*
- (21) *Brian Nosek, a psychologist at the University of Virginia in Charlottesville who ran the Many Labs 3 Project, thought the new study was a nice reuse of existing data. “We did not design that study to test ego depletion, but the authors discovered there’s a manipulation that’s common for ego depletion,” Nosek says. “I thought it was a creative application of data re-analysis.” But while the original studies on ego depletion did use a Stroop task and an anagram task, notes Greg Walton, a social psychologist at Stanford University, that doesn’t mean that ego depletion was the phenomenon that ended up being tested. “The assumption in the paper is that doing the Stroop test first would be depleting,” he explains (SN_S_2018-12-16).*

Overall, then, the representation of community discourse is mostly related to arguing and storytelling in individual blogs, whereas it is reported in more neutral terms, mostly referring to basic locutionary roles, in institutional blogs.

3.2. Action-Oriented Dialogicity

The central tools of action-oriented dialogicity are meta-statements and organizational units at different levels. Table 6 provides a list of the relevant keywords, lexical elements that can play a major role in representing the development of the text and the interaction that is taking place through the text.

The keywords thus identified can be grouped basically along two lines: lexical elements that mark the development of the text (“conclusion”) and elements characterizing reader engagement (“let’s”).

Reader Engagement is typically represented by imperatives, questions and directions (“let/let’s”, “read”, “here’s”, “note”, “notice”). These frequently represent the blogger as writer guiding the reader through the development of the argument (22), introducing the topic and the text under examination (23) or adding an aside (24) and guiding the reader through observation (25):

- (22) *Let’s suppose a bunch of scientists proposed to take one of the most infectious human viruses—influenza, say—and turn it into a super-bug. Is this a good idea? (GEN_2014-10-20).*
- (23) *Homeopaths did it again—they snuck a dubious study into a respectable journal. Well, sort of. Let’s quickly look at the study, and then look at the journal that published it (GEN_2018-10-15).*

- (24) *What was much more surprising, and deeply disappointing, was the response of candidate Ben Carson, who until last year was a pediatric neurosurgeon at Johns Hopkins School of Medicine. (Note that although I too work at Hopkins Medicine, I've never met Dr. Carson.) (GEN_2016-09-20).*
- (25) *Did you notice the bonus glacial striations in that last shot (on the left)? (MB_2018-06-23).*

Table 6. Action-oriented dialogicity: individual vs. institutional blog posts.

Keyword	Institutional Posts Frequency	Pttw	Texts	Individual Posts Frequency	Pttw	BIC
<i>Let</i>	176	5	107	75	2	38.44
<i>Conclusion</i>	77	2	37	15	0	38.32
<i>Interpretation</i>	48	1	21	4	0	37.41
<i>Read</i>	195	6	110	93	3	33.72
<i>Let's</i>	53	2	40	9	0	25.43
<i>Here's</i>	41	1	35	5	0	22.20
<i>Argument</i>	67	2	39	23	1	13.37
<i>Note</i>	98	3	75	45	1	11.99
<i>Arguments</i>	34	1	23	7	0	8.56
<i>Therefore</i>	94	3	58	47	1	7.27
<i>Statement</i>	50	2	32	20	1	2.83
<i>Notice</i>	34	1	28	10	0	2.76
<i>Examples</i>	42	1	36	15	0	2.55
Neg. Kws						
<i>While</i>	186	6	132	313	9	8.41
<i>How</i>	556	17	215	790	22	8.43
<i>Such</i>	311	10	148	486	14	10.62
<i>Whether</i>	76	2	54	162	5	10.80
<i>Although</i>	60	2	53	172	5	32.95

As we have seen, reference to discursive processes is actually often nominalized, and metadiscursive labelling nouns (“interpretation”, “conclusion”) act as cohesive (anaphoric or cataphoric elements) (26 and 27). The key role of labelling nouns in representing discourse and counter-discourse often builds up the main line of argument; as shown in (28):

- (26) *Something is definitely wrong with the uniformitarian story—why else would scientists be so surprised by the black rock and marine fossils? Could it be that all these strata—the red and black rocks—are deposits from the great Flood? This interpretation eliminates the mystery of how marine fossils are found sandwiched in between red sands and shale (MB_2014-03-18).*
- (27) *I present the structure as a fault-propagation fold, and in the second image I add my interpretation: the position of the fault changes from parallel to layering to where it ramps up and cuts across the footwall strata into the hinge of the syncline (MB_2019-02-24).*
- (28) *GMWatch, an anti-GMO organization, published a lengthy response to the Nobelists' letter the day after the letter appeared. Their rebuttal contains two arguments: first, that [...]; and second, that [...]. Hmm. Neither of these arguments stands up to even a tiny bit of scrutiny. First, [...] Second, the argument about relevant expertise is ridiculous. [...] I also have to point out that this is a classic ad hominem attack: [...] (GEN_2016-07-04).*

The only other cohesive element that features in individual blog posts is in fact “therefore”, a clear marker of conclusion. The other connectors found in the keyword list (“while”, “how”, “such”, “whether”, “although”) are preferably used in institutional blog posts to report debate, pointing at a multiplicity of positions to be balanced in concessive patterns (“while”, “although”) rather than at the line of argument that supports one position:

- (29) *While recent reports demonstrate that most low and middle-income countries have increased government health expenditure over the past decade, experts agree that it is overly optimistic to translate this into a model of autonomous national health spending without external support for the foreseeable future (PLOS_SoM_2015-07-13).*

Organizational units are best illustrated in the study of 4-word clusters. Individual blog posts are characterized by action-oriented clusters that involve both elements of reader engagement and metatextual organization, all of which have no occurrences in the corpus of institutional blogs: “it should be noted” (12 occurrences), “can be read here” (12), “as you can see” (11), “take a look at” (11). An example is reported below:

- (30) *Massive diamictites may be due to glacial deposits or to debris flows, but dropstones are a surer indication of glaciation. However, it should be noted that these strata are Devonian, and that plants had evolved by the Devonian (MB_2015-12-08).*

The only other 4-word cluster found that could be attributed to action-oriented dialogicity is the temporal organizational unit “for the rest of” (14 occurrences vs. none), often followed by ‘reversals’ introducing important changes in the plot of the narrative:

- (31) *Mayer returned to his hometown of Heilbronn in early 1841 and set up a medical practice there; this would be his main profession for the rest of his life. But he realized that he had discovered something profound about nature, and immediately began writing up his work for publication (SKU_2018-12-28).*

Once again, the analysis of key words and key-phrases points at stronger reader engagement in individual blog posts, with greater use of metatextual elements that highlight the argument and the narrative, while institutional posts are characterized by connectors introducing explanations and balancing diverse positions in concessive patterns.

3.3. Evaluative Dialogue

The set of keywords pointing to evaluative dialogue includes explicit evaluative language—expressing epistemic assessments, attitudinal assessments or markers of relevance [43,44]—and other markers, such as negative elements, that typically position the reader in terms of acknowledging or rejecting the need to negotiate topics and positions. Tables 7 and 8 list the elements that were found to play a role in this process, including all the elements found when focusing on individual blog posts in Table 7 and those found only when focusing on institutional blog posts in Table 8.

An overall consideration of the keywords suggests that evaluative dialogue is richer in individual blog posts. These are characterized first of all by an intense use of contracted negative elements (“don’t”, “doesn’t”, “didn’t”, “nothing”, “cannot”, “none”, “can’t”, “hasn’t”, “not”). Negation is arguably “a resource for introducing the alternative positive position into the dialogue, and hence acknowledging it, so as to reject it” [45] (p. 118). Negative forms are often used to clarify and contrast positions, especially in opening or conclusive statements:

- (32) *Now, the fact that Bérard has previously testified in court cases doesn’t prove that her current study is flawed, but it does indicate that she has a bias against antidepressants. This bias might explain why her study looked so hard to find an effect when the data don’t seem to support it (GEN_2015-12-21).*

Another important set of lexical elements can be classified as evaluative attitudinal language clearly ranging from negative to positive (“lovely”, “nonsense”, “beautiful”, “novel”, “nice”, “misleading”, “excellent”, “bad”). These highlight the central role of praise and criticism in the structure of these posts. The following extract provides an example, also showing how all the elements of evaluative dialogue are interrelated: explicit attitudinal evaluation (“misleading” and “ploy”), denial (“has not been evaluated”) and epistemic assessment (“could step in” vs. “they’ve already done”).

- (33) *Zicam’s website makes the misleading claim that “All of our Zicam[®] products are regulated by the FDA.” This is a common ploy of homeopathic drugmakers, claiming the FDA regulates them because the FDA could step in (as they’ve already done with Zicam) if consumers are being harmed. Unlike real drugs, though, Zicam has not been evaluated by the FDA for effectiveness or safety (GEN_2014-11-17).*

Table 7. Elements of evaluative dialogue: individual vs. institutional blog posts.

	Individual Posts Frequency	Pttw	Texts	Institutional Posts Frequency	Pttw	BIC
<i>Don't</i>	123	4	67	26	1	64.62
<i>Apparently</i>	97	3	67	14	0	64.37
<i>Doesn't</i>	77	2	45	10	0	51.60
<i>Simply</i>	140	4	89	45	1	47.10
<i>Lovely</i>	56	2	38	7	0	34.70
<i>Risk</i>	230	7	59	118	3	34.57
<i>Nonsense</i>	32	1	25	0	0	34.01
<i>Seems</i>	149	5	98	67	2	26.68
<i>Beautiful</i>	60	2	39	14	0	21.86
<i>False</i>	67	2	35	18	1	21.43
<i>Didn't</i>	40	1	35	5	0	20.95
<i>Novel</i>	109	3	35	45	1	20.35
<i>Must</i>	163	5	80	88	2	16.93
<i>Perhaps</i>	129	4	98	67	2	12.79
<i>True</i>	137	4	80	75	2	11.27
<i>Nothing</i>	105	3	80	51	1	11.08
<i>Obvious</i>	47	1	35	13	0	10.36
<i>Misleading</i>	26	1	21	3	0	9.71
<i>Nice</i>	58	2	48	21	1	8.25
<i>Excellent</i>	46	1	38	14	0	7.70
<i>Cannot</i>	75	2	57	33	1	7.53
<i>Compelling</i>	40	1	28	11	0	6.93
<i>Basically</i>	45	1	38	14	0	6.75
<i>Overall</i>	73	2	53	33	1	6.04
<i>Can</i>	1.041	32	285	1.362	38	4.71
<i>None</i>	55	2	40	22	1	4.45
<i>Can't</i>	32	1	21	8	0	4.34
<i>Literally</i>	26	1	26	5	0	4.20
<i>Supposed</i>	35	1	28	10	0	3.73
<i>Facts</i>	40	1	28	13	0	3.65
<i>Reasonable</i>	40	1	27	13	0	3.65
<i>Bad</i>	84	3	60	44	1	3.33
Neg. Kws						
<i>Happen</i>	35	1	31	74	2	−2.59
<i>Needed</i>	34	1	28	73	2	−2.31
<i>Important</i>	119	4	80	196	6	−0.96
<i>Suggests</i>	30	1	25	70	2	−0.51
<i>Enough</i>	117	4	83	199	6	1.08
<i>Suggest</i>	28	1	25	72	2	2.69
<i>Might</i>	268	8	155	403	11	2.71
<i>Can</i>	1.041	32	285	1.362	38	4.71
<i>Around</i>	183	6	113	308	9	8.08
<i>Potential</i>	64	2	41	168	5	25.63
<i>May</i>	285	9	150	515	14	33.78
<i>Could</i>	341	11	154	785	22	127.23

If elements of negation and of attitudinal assessment become prominent in individual blog posts only, epistemic assessments (expressions of certainty and probability) qualify both corpora. Individual posts, however, present a much wider range of degrees of certainty/probability, often including extremes that tend to dialogic contraction (34), while institutional posts are mostly defined by degrees of tentativeness and dialogic expansion (35):

(34) *So go ahead, drink your raw milk and eat a paleo diet too, while you're at it. But don't ask our modern medical system to pay for your treatment when you get sick. And most of all, don't subject innocent children to the unnecessary risks of raw milk (GEN_2014-04-07).*

(35) *Mars was once a wetter world, and according to a growing body of evidence, could have had water gushing through rivers, pooling in lakes and possibly even oceans (PHY_2014-03-31).*

Table 8. Institutional vs. Individual blog posts: other elements of evaluative dialogue.

Keyword	Institutional Posts Frequency	Pttw	Texts	Individual Posts Frequency	Pttw	BIC
<i>Expected</i>	63	2	54	21	0	4.78
Neg. Kws						
<i>Hasn't</i>	28	0	23	1	0	15.60
<i>Very</i>	295	8	165	407	13	16.60
<i>Good</i>	173	5	113	268	8	17.10
<i>Should</i>	215	6	122	318	10	17.46
<i>Not</i>	1.176	33	328	1.404	43	33.89

The key 4-word-clusters characterizing individual blog posts include two clusters revolving around the verb “turn out”: “turn out to be” and “turns out that”. The first cluster—“turn out to be” (15 occurrences)—is followed by predicates that are often comparative or refer to successive interpretations of facts: “other viruses”/“something else”/“true” (2)/“just a pose”/“on the whole sane”/“a big deal”/“safe and effective”/“false”/“wrong”/“somewhat less spectacular”/“useful”/“the chance of a lifetime”/“quite prophetic”/“due to quantum effects”, as in example (36). The cluster “it turns out that” (12 occurrences) also connects contrastive or contradictory statements while showing that something proves to be true/false against all expectations, as in example (37).

(36) *Lovecraft's laymen's view of astronomy would turn out to be quite prophetic (SKU-2016-11-20).*

(37) *When looking at the effect of gravity on the wave properties of matter, however, something strange happens. It turns out that the wave properties depend explicitly on the mass of the particle divided by Planck's constant, known as “h-bar.” (SKU_2015-05-20).*

When looking at key-clusters, then, individual blog posts appear to be characterized by the narrative voice of the blogger, who constructs sequences of unexpected reversals in the process of discovery. The patterns created by the various constructions of “turn out” highlight the dynamicity of ever-changing perspectives on science that invariably prove to be confirmed or disconfirmed by later views. Emphasis is placed on an unexpected change in perspective and on a narrative of science that creates sequences of conflicts and resolutions, where facts are interpreted and reinterpreted.

In institutional blog posts, on the other hand, evaluative dialogue is represented by 24 occurrences (in 24 texts) of “is one of the”, totally absent in the other corpus. This constitutes the kernel of an identification sentence typically introducing (often comparative) evaluative expressions such as “hardest features”, “best things”, “most fascinating developments”, “many reasons”, “world's rarest lifestyles”, etc.

(38) *Magnesium is one of the lightest metals on the periodic table (PHY_2018-03-27).*

The only other evaluative element to be noticed is “will be able to”, characterizing moves that explore the implications of discoveries or events announced:

(39) *Going back through the Landsat archive didn't reveal any big changes in penguin diet, but now researchers will be able to monitor it as the region changes and provide real data to Antarctic ecosystem managers (SN_WT_2019-01-02).*

What becomes dominant in institutional blogs is the voice of the blogger taking position as to the facts he or she introduces, by assessing their importance or presenting the implications. The voice of the blogger is less explicit in expressing opinions but more careful in guiding the readers towards forming an opinion.

4. Conclusions

The qualitative analysis of quantitative data has confirmed the importance of looking at different aspects of dialogicity when studying variation across individual and multi-authored blogs. It has also hopefully shown that the complex set of elements that constitute dialogicity can contribute to defining how bloggers manage subjective and intersubjective positioning and construct their credibility in ways that also define the nature of their relation to the audience and ultimately to the functions of blogging.

The study of participant-oriented markers has confirmed that individual blogs (un-surprisingly) favour reference to the first- and second-person pronouns. The greater prominence of the personal identity of the blogger is also accompanied by qualitative differences: individual blogs highlight the biographical self of the blogger and their writer self, while also making the identity of the academic more clearly linked to the educational dimension; institutional blogs tend to favour patterns of attribution. The qualitative difference thus proves to be more interesting than the quantitative: individual blogs produce more personal, idiosyncratic writing and construct an authorial identity that emphasizes biographical elements of the blogger, while institutional blogs construct a more neutral identity of the blogger as expert in research, typically balancing the voice of the blogger with the collective voice of other researchers and offering a wider picture of the debate within the community.

The representation of dialogue within the community turns out to be a relevant distinctive element. Institutional blogs tend to favour a wider representation of communicative action, but one that is largely limited to the most neutral forms of reporting, mostly referring to basic locutionary roles. Individual blogs give greater prominence to storytelling and to the role of the blogger's argument (i.e., to patterns of claiming and counterclaiming), highlighting the position of bloggers in debate with sources as members of the discourse community. In both cases, blogs allow for a representation not only of the blogger's position but also of a debate with a range of positions. What changes is rather the role of the blogger: more explicitly interacting with the sources in one case and rather preoccupied of accurately reporting the range of positions in the other.

Similarly, action-oriented forms of dialogicity offer a picture of individual blogs emphasizing writer–reader direct argumentative dialogue, with institutional blogs presenting a more expositive position. Individual blogs present a more marked preference for reader engagement, with greater use of metatextual elements that highlight the argument and the narrative, while institutional posts are characterized by connectors introducing explanations and balancing diverse positions in concessive patterns. In some way, the representation of dialogue within the community and the representation of dialogue with the reader appear to converge: they both suggest greater emphasis on disseminating knowledge content in institutional blogs and greater emphasis on bonding and bridge building (as well as self-branding) in individual blogs.

What is most important, given the key role of evaluative language in blogs, is the way bloggers construct an evaluative dialogue with their readers. Evaluative dialogue is much more clearly highlighted in individual than institutional blogs when looking at quantitative data. Institutional blogs tend to feature more careful epistemic expressions, mostly testifying degrees of tentativeness and forms of dialogic expansion, assessing the importance of facts reported, presenting implications and guiding the readers towards forming their own opinion. Individual blogs, on the other hand, are characterized by a wide range of evaluative elements: negative forms used to clarify and contrast positions, attitudinal items expressing praise and criticism and a wide range of epistemic markers often including extremes that tend to dialogic contraction. Evaluative dialogue thus further contributes to highlighting different functions of blogs—bonding and self-branding in individual blogs vs. knowledge dissemination in institutional blogs.

The analysis thus confirms the expectation that blogs managed by individual scientists emphasize personal, narrative and argumentative voice together with interpersonal elements, while institutional blogs are comparatively more neutral and informational. It also

points, however, towards a distinction that involves much more than the relative presence of personal elements. By linking self-mention to the representation of the community and of writer–reader interaction with a special focus on evaluative dialogue (and how evaluation contributes to subjective and intersubjective positioning), the study also reflects how different language markers could point to different general functions often attributed to blogs: outreach and self-branding.

It should be noticed, of course, that the distinction between bloggers’ identities in the two datasets is not just a matter of individual vs. collective identity, as individual and collective identities are always present in both contexts. An important factor could be that writer voice in institutional blogs may be influenced by the presence of the institution itself as website “principal” (Goffman 1981), taking responsibility for the web space that hosts the blog, and superimposing less personal forms of authoritativeness. The credibility and reputation of the institution somehow reflects on the individual voice, possibly having an impact on the peculiar combination of authorial voices found in the two corpora: the voice of the pundit is constitutively dominant but it leaves greater room for the biographical self and the academic lecturer in individual blogs, while emphasizing the researcher and the dialogue between researchers in the community in institutional blogs.

What becomes evident is that the multiplicity of voices involved in institutional blogs and the multiplicity of identities manifested by individual bloggers determine noticeable variation across these two types of ‘scientific blogs’. The presence of more or less personal forms of voice confirms the prominence of writer identity(/ies) in blogs: while blogs often blur the distinction between expert and non-expert audiences [4], they seem to maintain the need to manifest the self of the blog(-ger) in the different forms that may be relevant to establishing credibility and trust. The credibility of the individual scholar seems to rely on different elements in the two types of blogs. On the one hand, in institutional blogs the voice of the blogger relies on the authoritativeness of more neutral language and probably thrives on the authoritativeness of the institution. On the other hand, individual bloggers deliberately avoid the neutral and objective language typically associated with the discourse of science, blurring their private and public identities and variously relying on the credibility of an academic self or on the trust inspired by a private (“ordinary person”) persona.

In a general climate of public distrust in experts and science, scientists may thus tend to make recourse to two basic strategies: adopting the more neutral stance of journalistic reporting or collapsing their public and private personae to shift the discourse plane to personal “one-to-one” interaction. The representation of authorial identity, however, is only fully understood within the framework of the representation of the debate within the community and the representation of writer–reader interaction. It is only by looking at the full range of elements that we can see how the blogger and the reader are positioned as to the issue at hand and the wider debate, as well as how they are oriented to outreach or reputation management.

The study presented here clearly has a number of limitations, primarily related to the corpus and to the methodology. The corpus is quite obviously limited and almost inevitably not really balanced from a disciplinary point of view: as the idea behind the development of the corpus was to make it comparable to other disciplinary fields (e.g., the social sciences) and to explore the comments as well, the corpus is limited in size and the analysis could be confirmed or disconfirmed by working on a different set of blogs. When comparing individual and multi-authored blogs, moreover, disciplinary interests are also obviously varied. A focus on disciplinary argument would require a totally different set of blogs, maybe developed around a specific topic and comparing an equal number of bloggers who write for their own blogs or for multi-authored institutional blogs. Along the same lines, it would be interesting to develop a comparison between a wider set of multi-authored blogs connected to disciplinary organizations and blogs connected to popularizing magazines, to observe if there is variation in the representation of scientific communities. The methodology adopted—starting from word forms that are statistically

more or less frequent in one corpus than in the other—also has its limitations as it tends to highlight differences between the two subsets. A more specific study of each blog might reveal other interesting elements of commonality or divergence. Finally, given the key role played by reader engagement and evaluative dialogue in defining the nature of the two types of blogs, a closer study of these two perspectives might further illuminate their respective contribution to the distinction between these two types of blogs and to how they contribute to outreach and/or reputation management. Hopefully, however, the study has provided a basis for further exploration of the nature of research blogs and their role within the system of options available for science communication.

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Notes

¹ <http://www.fieldofscience.com/p/about.html> (accessed on 20 January 2022).

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Article

Claiming Credibility in Online Comments: Popular Debate Surrounding the COVID-19 Vaccine

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Abstract: At times of crisis, access to information takes on special importance, and in the Internet age of constant connectedness, this is truer than ever. Over the course of the pandemic, the huge public demand for constantly updated health information has been met with a massive response from official and scientific sources, as well as from the mainstream media. However, it has also generated a vast stream of user-generated digital postings. Such phenomena are often regarded as unhelpful or even dangerous since they unwittingly spread misinformation or make it easier for potentially harmful disinformation to circulate. However, little is known about the dynamics of such forums or how scientific issues are represented there. To address this knowledge gap, this chapter uses a corpus-assisted discourse approach to examine how “expert” knowledge and other sources of authority are represented and contested in a corpus of 10,880 reader comments responding to Mail Online articles on the development of the COVID-19 vaccine in February–July 2020. The results show how “expert” knowledge is increasingly problematized and politicized, while other strategies are used to claim authority. The implications of these findings are discussed in the context of sociological theories, and some tentative solutions are proposed.

Keywords: COVID-19; health communication; user-generated content; reader comments; social media; vaccines; vaccine denial; conspiracy theories

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1. Introduction

The scientific evidence on any given topic today is often extremely complex or even contradictory, posing difficulties for the journalists who report on it and the public who read about it, as the COVID-19 pandemic has made abundantly clear. Research on issues such as infectious disease, vaccination, genetically modified food or climate change generates massive amounts of data and relies on increasingly sophisticated subject knowledge and statistical analysis for interpretation, so that strong scientific literacy skills may be needed to discern important trends or evaluate speculative ideas. The abundant coverage of scientific topics in the media of all kinds means that people are constantly being bombarded with information about health, disease, diet, climate and so on, and although much of this reporting may be accurate, it is very likely that large sectors of the public lack the background needed to evaluate the kind of claims made and what they mean for the average person [1,2]. If we add to this the massive proliferation of user-generated comments, misinformation and disinformation on social media, the situation becomes even more confusing. In the light of recent global health crises such as COVID-19, which pose a significant risk to the general public, this scenario is a growing cause for concern among health authorities, governmental and international bodies, but unfortunately, little is known about how scientific information is formulated and communicated in informal public settings.

Social media experts and discourse analysts have made various attempts to address the situation of public incomprehension of scientific information. One first possible starting point is the notion of scientific consensus, a key concept, but one that is poorly understood. In fact, there is some evidence that the public is receptive to the notion of a division of

cognitive labor, and to the idea that scientists, say, as opposed to politicians or celebrities, have privileged knowledge of health or environmental issues and that a consensus among them has greater weight than a mere agreement among lay people [3]. On the other hand, opinion polls show that people frequently fail to recognize that an expert consensus exists or misunderstand its nature [4]. This has been attributed to false media bias, that is, the media's tendency to present issues as a two-sided debate, even when the preponderance of evidence is on one side [5,6]. It may also be due to misinformation spread by groups opposed to specific health policies [7]. In view of this, some authors believe that it would be useful to educate the public on how scientific research works and try to correct misperceptions concerning the nature of scientific consensus. It has been proposed that a better comprehension of expert consensus would act as a "gateway belief", enabling positive changes in public attitudes [8]. One further twist to this story is that official reactions to some recent health scares were found to be counterproductive, leading to public mistrust of information campaigns and a general reduction of people's risk perception [9], undermining the notion of a reliable expert consensus in many people's minds.

A second point of departure is to examine user contents themselves to find out about their dynamics and reach a deeper understanding of what leads people to be receptive to mis- or disinformation. Although the messages that circulate at the grassroots level among lay publics might be regarded as unimportant in discussions of public health policy and communication, it is increasingly becoming clear that these representations have power to sway the debate and color the public vision of important issues [10]. In studies of social media messaging in some recent epidemics, it was found that there is an alarming tendency to express distrust in official public health information and delegitimize official health spokespeople [11]. In this sense, some authors have argued that precisely in this context of emerging diseases where public health information is of paramount importance, it is essential to learn more about how social media users access, understand and pass on health-related information and how they perceive health risks [11]. Although health authorities increasingly use social media to provide information, they rarely engage in two-way interaction with their audiences, and large amounts of contradictory advice or deliberate disinformation also circulates through the same channels. Moreover, it would be naive to assume that even if clear messages are issued, the public as a whole would ever simply accept messages transmitted by authorities as true, providing these are suitably phrased. This would go against a large body of reader response research assembled over the years [12], which shows that readers are active agents, well capable of generating critical or deviant readings of the texts to which they are exposed. Evidence from a recent experimental study [3] shows that people who have already formed an opinion about a controversial issue are less likely to see health-related messages as representative of the scientific community as a whole, even if they are expressed in terms of high consensus. In fact, we know that the information provided by reliable sources on health-related topics is generally filtered through readers' values and pre-conceptions [13] and is strongly influenced by the well-known phenomenon of confirmation bias [14,15]. While some people are willing to modify the way they understand an issue, others cheerfully resolve cognitive dissonance simply by rejecting ideas that do not fit with their own preconceived notions [16].

In short, the combination of conflicting authoritative accounts or hyped campaigns, information overload and massive social media interaction generates widely divergent social constructions of health risks and how they should be avoided [10]. The complexity of such situations is nowhere more clearly manifest than in the case of COVID-19 vaccination and vaccine denial. In this particular context, a bewildering proliferation of fact, opinion, fake news and disinformation is circulating through user-generated media, strongly laced with personal experiences, strong feelings and violent reactions. In the midst of this, a substantial minority of people persistently resists official health messages issued by governmental authorities and not only heed alternative views but also propagate them.

In principle, then, it is important to obtain a better understanding of the dynamics of health-related interactions in social media networks, and how official and expert opinion are received there. This would complement other focuses, such as sociological studies of vaccine denial or communication studies about how to explain health issues, by shedding light on the way messages are received and relayed by members of the public. However, such studies are rare, probably because one of the main problems facing anyone who wants to understand what is happening in such venues is the sheer quantity of comments, almost all of which are available only in fragmentary form. Although user-generated media have proliferated in recent years, with massive circulation of news and opinions through Facebook, Twitter, reader comments pages and so on, their incomplete nature and the absence of continuous coherent discourse means that they still pose a major challenge to analysts [17]. For this reason, the focus is limited to the way “experts” were represented and the way commenters otherwise constructed their claims to knowledge about the pandemic and vaccination issues. This made it possible to cut through the vast mass of data obtained from one reader comments site on COVID-19 vaccination by conducting a corpus-assisted search for a number of frequent key terms (representations of expertise, ideas and ways of knowing, roles in interaction, etc.), to perform a vertical reading of the main ways in which expert authority, credibility and knowledge were represented in this dataset. The main research question to be addressed is thus: how is “expert” knowledge represented and/or contested in this forum, and what other kinds of authority do people claim or draw upon?

2. Materials and Methods

The *Mail Online* is the web version of one of the most widely read British tabloid newspapers, the *Daily Mail*, a right-wing daily with a circulation of around one million copies. Thanks to its open access policy, it has a vast online readership with one of the most active reader comments pages in the UK. This chapter examines a corpus of 10,880 reader comments responding to all the *Mail Online* articles containing substantial coverage of the COVID-19 vaccine development program published between 28 February and 23 July 2020 that generated more than 10 comments (see Appendix A for the full list of articles included). This dataset thus represents the crucial period during which the first vaccines in the UK, USA and elsewhere were undergoing clinical trials (the first vaccine was approved for general use in December 2020). A total of 25 articles were identified that met these criteria, and the reader comments were scraped from the online newspaper site using a web scraping application developed using the R environment for statistical computing and text processing. In accordance with a corpus-assisted discourse analysis approach [18], the most frequent search terms related to sources of expertise (e.g., “vaccine”, “vaccination”, “expert”, “doctor”, “scientist”, “scientific”, “pharmacist”, “research”, “government”, “NHS”), ways of knowing (e.g., “know”, “think”, “idea”) and interpersonal interaction (pronouns “I”, “you” and “we”; interaction markers “OK” and “so”; imperatives and direct questions) were used to extract all relevant concordance lines. These were then analyzed qualitatively in order to determine the strategies used by participants to attract attention, build their own credibility and undermine that of others and appeal to or dismiss authority. After a reiterative process of reading and re-reading the relevant comments, these were assigned to four major themes reflecting different attitudes to the issue of scientific authority. The examples in each category were analyzed through a further process of reflective reading in order to establish how these commentators discursively framed the status of expert knowledge and the “right” to have an opinion on COVID-19 vaccines. The process of analysis was thus similar to a classic thematic analysis, rather than one based on quantitative criteria. In the presentation of the results below, the four recurring themes are illustrated and discussed in order to shed light on the broad patterns that characterize the public discussion of vaccines in this platform, but the design of the study does not permit comparisons regarding frequency, for which it would have been necessary to code and quantify all the comments individually along the

lines of content analysis. The conclusions suggest how these findings could be useful for professionals engaged in providing public health information.

3. Results

3.1. The Contested Nature of “Expert” Knowledge

One of the most often used strategies employed by traditional media sources for boosting the credibility of scientific and health-related information is that of referring to “experts”, generally elite scientists/researchers and official spokespersons [19]. This trend was also perceptible in some reader comments that cited “experts” uncritically as agents with privileged knowledge that they place at the service of society. We may note how the plural form, sometimes with the definite article, implies a reliable consensus, as evidenced by examples (1) and (2):

- (1) *I think with the information we had from the **experts** we’re doing the best we can.*
- (2) *I owe my life to the skills and **experts** who work in big pharma.*

A few contributors display more familiarity with the gatekeeping mechanisms of science, as shown below, but none of the examples in the present corpus made reference to the notion of scientific consensus (3):

- (3) *There is no peer reviewed scientific research that says **vaccines** are unsafe or they are a way of controlling people.*

This confidence in (unspecified, presumably authoritative) experts is here sometimes underpinned by belief in accepted British establishments, often expressed in markedly patriotic terms (4)–(7):

- (4) *He’s not one of our **experts**. We have a far more talented pool of academia at Oxford and Cambridge.*
- (5) *This is the one and only Oxford if they say they’ll have a **vaccine** by fall, I will take them for their word Sorry Bill Gates, someone beat you to it.*
- (6) *Congratulations British **scientists** for being the best in the world.*
- (7) *Through all of this there’s one thing I’ve been totally confident of—the finest **scientific** minds on this planet are right here in Britain.*

However, it is notable that in this dataset, the attribution to an “expert” was far from universally accepted as a way of legitimizing a claim. Out of 213 occurrences of this lemma, 157 were here associated with a negative semantic prosody, in which the credibility of the experts or “experts” was undermined. In most cases, this was delivered in ironic terms (8)–(10):

- (8) *Was it a DM Australian **expert** that created it out of herbs and spices?*
- (9) *And just who are these mysterious sources and **experts**. Is it Brenda at number 47 because apparently she’s an expert on this?*
- (10) *Everybody is an arm chair **expert** these days.*

One of the phenomena observable in the media during the pandemic months was the emergence of public figures of many different kinds—often lacking any scientific expertise—who made statements about how the pandemic should be handled. The obvious ironies of this are clearly perceived by various commenters, who pick up on claims made by people who are felt to lack medical expertise (11) and (12).

- (11) *Bill Gates is now a medical **expert** advising the world!*
- (12) *How nice to see that acclaimed doctor and **scientist** (probably a Nobel Prize winner) Elle Macpherson giving us all the benefit of her huge intellect and years of good scientific research and experience.*

Notably, inverted commas are often used to underline this critical, ironizing stance towards experts, as in (13) and (14):

- (13) *I’m still waiting for the DM to publish its usual realistic article by its ‘**expert**’ astrologers on which star signs will catch the virus.*

- (14) *Next they will be telling us not to obey the traffic lights. The 'experts' have cried wolf so often that nobody knows what to believe.*

More worryingly, some participants appeared to dismiss the possibility of expert knowledge, in a tone reminiscent of populist political campaigns [20,21] (15) and (16):

- (15) *Better be fake news Forget experts! Like I said 3 days ago. If you listen to experts you are done and dusted Experts don't know anything.*
 (16) *Does anyone else want to just scream when they hear the word Expert anymore?*

This is often linked explicitly to populist distrust of government, which is allied to distrust of experts (17):

- (17) *Mishandled from the beginning by government and their so-called experts.*

This fundamentally populist theme is developed through allusions to an establishment conspiracy and is given greater appeal by references to the class system. In the following comment, it can be observed how the vaccine is associated with the despised “middle class know-it-alls” (18) or “elites” (19) who have a contemptuous attitude to “independent researchers” while having a vested interest in the pharmaceutical establishment:

- (18) *The middle class know-it-alls will be the first to roll up their sleeves. The ones with pension stock in Astrazeneca who look down their noses at anyone who does any independent research. We all know one or two of them.*
 (19) *I would rather be dead than be forced to have a vaccination and be controlled by the elites!*

Another pattern that recurs in this dataset is the expression of frustration with an overload of “expert opinion”, a view which probably reflects considerable public confusion over the way in which the media tend to stack their articles with brief statements from scientists and spokespeople of different kinds, and which could easily produce fatigue in media consumers (20) and (21):

- (20) *All I see in this article are unfounded opinions and assumptions from numerous “sources, experts, professors” nothing more.*
 (21) *Anti vaxxers, and especially this doctor, prove that qualifications do not mean a person is intelligent and understand what they supposedly “know”.*

However, it is very striking that while experts are widely denigrated by participants who are skeptical of mainstream science and establishment viewpoints, another frequent pattern found here is the term “expert” used with positive valence in order to build support for alternative (non-consensus) views of the pandemic (22):

- (22) *Despite a massive and coordinated attempt to silence alternative voices, many of them experts in their field, the message is getting through that there has not been a pandemic.*

Alternative views of vaccination are also expressed in this context (23)–(26):

- (23) *ARE PEOPLE NOT ENTITLED TO BE SUSPICIOUS?? there are many “experts” who disagree with the current vaccine programme....that doesn't mean they are anti-vaccine types.*
 (24) *Dr. Wolfgang Wodarg, an experienced doctor, said In reality, this “promising vaccine” for the vast majority of people is in fact prohibited genetic manipulation!”*
 (25) *I refused to have it after reading what is in the vaccine. About 20,000 doctors and nurses also refused to be vaccinated so they can't be wrong either.*
 (26) *As a pharmacist with 26 years' experience I agree with Wakefield.*

A lack of transparency in the medical profession is also occasionally cited as a reason why readers distrust mainstream scientific messages (27):

- (27) *Doctors who have twenty to thirty years' experience couldn't tell me any ingredients in any vaccine over the years. Yet they want to believe and make us believe that vaccines are safe and effective.*

The patterns emerging here point to the contested nature of “expert” status. On the one hand, there is a public perception that some people (medical doctors, scientists) do have access to privileged knowledge and thus do have the “right” to speak and be listened to. However, consensus of scientific opinion is not mentioned explicitly in any

of the posts, even in statements where “experts” or “the experts” are cited as providing authority. Although it is difficult to build a strong argument on negative evidence, this absence seems to suggest that the notion of consensus is not prominent in public framings of scientific affairs. Conversely, some figures who are prominent in the media discussions of COVID-19 do not have this status, and their opinions are not granted credence. On the whole, participants reject the media practice of publishing the views held by celebrities on this topic. However, this picture is complicated by the fact that in the representations of some participants, at least, certain people who do not represent mainstream scientific opinion can also be defined as “experts”, and their views are given equal or superior weighting.

3.2. Claiming the Right to Speak

It is noticeable that when the participants express their own ideas, they often feel obliged to provide some reasons why they feel they have the right to speak on this topic, or else admit their lack of expertise before indicating why they think this does not disqualify them from opining on the subject. Let us look first at those participants who claim personal expertise or contact to underpin their right to speak. The epistemics of everyday interaction broadly revolve around knowledge imbalance among participants, and the fact that they recognize each another to have different levels of knowledge about a specific field or point [22]. We may note that the kind of experience claimed is presented rather vaguely, ranging from healthcare in general (“I work in the NHS”) (28) and (29) to more specific descriptors indicating a direct link with COVID-19 (30)–(32):

- (28) *I know I work in the NHS.*
- (29) *I work with covids. Some have no symptoms, some have only a sore throat, others require oxygen or mechanical ventilation. The ones that didn't know they had it, infected others*
- (30) *I work in vaccine manufacturing and to be fair there is a small risk in all vaccines having a side effect but this on the whole is negated by the benefits.*
- (31) *I worked for a global pharmaceutical company for 15 years. They're only about profiting from Patient Care.*
- (32) *I'm a hospital based physician with decades of experience. I'm involved with caring for patients with C19. I've read everything there is to read on the subject.*

Participants bring in first-hand experience as a potential source of trustworthy information. On the one hand, people who have had personal contact with the disease are keen to share their experience (33) and (34):

- (33) *Sadly the virus is not a hoax as I lost someone and my friend lost her brother but I do believe that the vast majority of the population is safe.*
- (34) *I know several people who have had covid and have after affects. These people are young. Its not simply a mild cold or flu. Dont be deluded.*

On the other, those who lack personal experience of it apparently feel authorized to shed doubt on its existence (35):

- (35) *In a few months the virus will be gone. Just before we all panic, does anyone personally know someone that has it yet?? I dont and havent met anyone that does know someone!!*

Notably, even conversations with people who have some professional expertise are also presented as authorizing moves to claim epistemic rights (36):

- (36) *Just been talking via Skype to a friend of mine who's a doctor who I used to work with many years ago and we were talking about vaccines and he said he would not recommend anyone having a vaccine that has been rushed through in less than a few months.*

In the case of people who lack professional contact, the use of a “disclaimer” often precedes the claim (37) and (38):

- (37) *I'm not proclaiming to be an expert, but wouldn't it make more sense injecting the partial gene sequence into a larger animal?*

- (38) *I'm no doctor but it would appear that the side effects of the vaccine may include contracting Coronavirus.*

However, in many cases an appeal to common knowledge is used, again generally presented before the claim (39)–(44):

- (39) *All **cures** will be downgraded by our media until after November (and we all know why)....*
 (40) *We all know China started this mess with the intention of hurting innocent people.*
 (41) *We all know there will be no vaccine this year*
 (42) *Covid 19 won't be here again. We'll all know this. We've been conned folks. Big Pharma runs the world.*
 (43) *We please all know, the world knows, Trump has been an inept, incompetent, leader.*
 (44) *We all know Bill Gates is behind this, that alone should send folk running to the hills.*

Other people appeal to “common sense” to found their arguments (45) and (46):

- (45) *Vaccines take 10-15 years to be developed and deemed safe for humans so **common sense** should tell you that they have had this vaccine for many years*
 (46) *A vaccine is a weakened version of whatever your body is going to generate antibodies for, whatever happened to good old fashioned **common sense**.*

Along similar lines, participants occasionally draw parallels between medicine/science and other aspects of life (47):

- (47) *Sensible shoppers always check out what they are buying or look at food labels for nasty additives. But when it comes to injecting stuff into our bodies, few ask their doctor what's in it—and most doctors probably don't really **know**.*

There is also evidence in this dataset that some people are operating from very different underlying constructions of reality. In the following case, we can observe how some anti-vaccine participants build a link to various other conspiracy theories current at this time (NWO, Gates, 5G, microchips), which come together to build what might be termed an alternative worldview that has inner coherence but is incompatible with the mainstream representation of the issues [23,24] (48) and (49):

- (48) *A mass march on the authorities is in order after the numbers fall!!!!!!!!!!!! This is all a con from the New World Order, Bill Gates can p@ss right off if he thinks he's giving it to **me!** Full of nano technology to go hand in hand with 5G which they cant I dont want that crap injecting into my viens developed by Bill ppphhhooking Gates, the man is a megalomaniac!!!! people are flaunting the rules everywhere. the police cant stop everyone doing it, its futile.*
 (49) *No **vaccines** are good enough to stop powerful 5G beams entering the body and causing covid FACT*

3.3. Denying the Right to Speak

A large proportion of the posts that reject a previous participant's claim found their argumentation on the notion that contributors lack intelligence or a sound understanding of science. These are usually delivered in insulting terms (50) and (51):

- (50) *We all **know** the immense brain power tabloid “readers” possess.*
 (51) ***Know** it alls on virology out in force today, **you** lot should really do a little research on how viruses & the immune system actually work before commenting on this nonsense state the bleeding obvious!?!?*

Sarcasm is also used to delegitimize others' claims (52):

- (52) *I didn't **realize** the UK was blessed with so many keyboard scientists and doctors who appear to know so much more than real doctors and nurses on the front line.*

Participants delegitimize anti-vaccine opinions by exaggeration, mocking their epistemological naivety (53) and (54):

- (53) ***OK so** by anti **vaxxers** way of thinking “one of my friends children had the mmr **vaccine** and developed autism “ . . . ” one of my dads friends ate a banana and got cancer” Total twaddle, does he still believe the Earth is flat! Measles can kill and can cause blindness.*

(54) *I love a good conspiracy theory as much as most people. The moon landing, JFK, Princess Di, 9/11, 5G, etc. etc. But if **you** look at the number of lives that have been positively impacted by vaccines **I** simply don't buy it.*

For their part, those opposed to the vaccine generally represent people who support it as lacking the ability to think for themselves: they are “under complete mind control” or “willing sheep” (55):

(55) *There are loads of willing sheep who will accept any poison if they are fed by the **government**.*

Other sources of legitimation mentioned in the foregoing section, such as “common sense”, are also disputed in sarcastic terms (56):

(56) *What we want is a **common sense** vaccine from someone like Nigel Farage or that bloke who owns Wetherspoons.*

Thus, both sides are represented as gullible and naive: antivaxxers are “flat earth” and “dense and ignorant”, while pro-vaccine participants are “under complete mind control”. Disputing the right to speak involves discrediting adversaries by attacking their intelligence or ability for independent thinking, but also attacking their credibility in rational terms (57):

(57) *This sort of muddled thinking is really unhelpful. **Try looking up** how vaccines work. **Educate yourself.***

Importantly, a party-political dimension is often apparent in these posts, with a clear alignment proposed between certain political stances and certain stances towards mainstream COVID-19 health policies. Predictably, perhaps, a position that is critical of the Conservative government tends to be distrustful of official health policies (58) and (59):

(58) *Vaccine should be ready when mostly elderly people have passed away exactly what this **Tory government** wants.*

(59) *Has Oxford developed the Boris vaccine? Full of promise but poor on delivery.*

More interestingly, perhaps, Brexit-related issues appear in a variety of ways. Through processes of assimilation that involve considerable simplification and are doubtless intended to be offensive, Remain voters (60) and (61) are denigrated as disloyal to Britain and are grouped together with supporters of Bill Gates (60), while Brexit voters (62–63) are positioned with conspiracy theorists such as David Icke (63).

(60) *Great but they should test it on remainers **Take Bill Gates' vaccine you sheep.***

(61) *Remain supporters should wait for the EU to provide it, while those who are confident in our country as an independent nation can benefit from the **vaccine***

(62) *I hope it is tested on Brexit voters and other expendables before it is given to important people such as **myself***

(63) *Brexit voters won't take this **vaccine** because David Icke told them not to.*

It is striking that a few voices on these highly combative discussion boards are raised in support of “debate”, that is, hearing both sides of the question (64):

(64) *I respect anyone who is pro vaccine. But **I** also want to hear opposing views without name calling.*

However, at the same time, suggestions are frequently made that debate is being closed down (65) and (66):

(65) *Giving up, obviously only certain **ideas** are allowed on here*

(66) *Trump has the right **idea**, obviously misinterpreted as per usual by the media but the hydroxychloroquine treatment works.*

3.4. Sources of Authority

As the above sections have shown, while some commenters express trust in authoritative institutions such as the political establishment, scientific or university research centers, for others any messages emanating from such sources are merely part of an establishment conspiracy. Their distrust in politics, or in the scientific establishment, or in the media,

leads them to seek certainty in other representations that purport to speak with authority, often making them fall victim to conspiracy theories. At the same time, a large number of people seem to rely mostly on first-hand experience, “common sense” and even hearsay in order to construct their own view of the pandemic and the vaccine. In particular, those with personal experience seem to feel authorized to contribute their opinions. Table 1 shows the way in which different sources of authority are broadly represented by those in favor of and critical of the proposed vaccine.

Table 1. Sources of authority in pro- and anti-vaccine comments.

Source of Authority	Pro-Vaccine Commenters	Anti-Vaccine Commenters
Government	Government has the responsibility and knowhow to solve the pandemic through appropriate vaccines.	Government uses vaccines to increase its power and reduce citizens’ personal freedom.
Scientific establishment	Scientists have access to privileged knowledge and place this at the service of society. Scientists provide accurate information and advice.	Universities/research institutes are part of the (political and social) establishment and only seek establishment interests. Scientists are anxious to push the vaccine through too quickly for personal gain.
Pharmaceutical companies	Companies research and produce vaccines in a highly professional way.	Companies generate large profits by producing vaccines.
Alternative scientific sources	Alternative sources are discredited, associated with conspiracy theories.	Alternative sources are well qualified but persecuted by the establishment.
Primary investors	Investors such as Bill Gates are a legitimate source of authority.	Investors are only interested in profit or control.
Media	Media provide clear information. Media give contradictory information that must be filtered. Media give too much credence to alternative theories.	Media brainwash the public and give too much credence to “official” sources. Media are at the service of government, establishment and “big pharma” and silence alternative voices.

4. Discussion

This chapter contributes to the growing body of research on the social media reception of health-related topics, and sheds light on the construction of authority and knowledge claims in online forums. This discussion begins by addressing the findings concerning the contested notion of expert status and knowledge, which has considerable political and cultural implications. To conclude, some possible implications for public health communication in contexts such as the 2020–2021 pandemic are explored.

Regarding the first research question, namely, how “expert” knowledge is represented or contested in this forum, the most striking finding from this study concerns the way trust in experts is vehemently contested. Let us first approach this in terms of the grassroots epistemological premises operating in society. In general terms, a claim is thought to be more likely to be accepted if it is backed by someone who has a privileged position for knowing thanks to his/her superior knowledge and training (see [25–29] on “epistemic authority”). However, although this is in itself a reasonably compelling principle, in the media context, it is currently being subverted by three trends observable here. First, the mainstream media themselves show increasing confusion over who can claim to be an expert on science-related topics and have, on occasion, been indiscriminate in according equal status to statements by established and alternative figures, as was the case during the MMR vaccine controversy [5,6]. Secondly, fake news sources, including deliberate disinformation, also regularly have recourse to “experts” in order to bolster their claims [15] to such an extent that some commentators have even proposed that vague reference to “experts” could serve as a marker of fake news [30]. Finally, social media in particular suffer from a notorious degree of epistemological simplification and flattening: as Salaverria et al. [31]

point out, there is an observable trend for users to attribute the same level of authority to anyone remotely close to having special knowledge (i.e., a general practitioner's opinion is held to be equal to that of a specialist virologist, or one COVID-19 victim's experience is accorded more weight than statistical data obtained across a huge sample). In a radical approach to this phenomenon, Harsin [32] posits that many people now operate within a post-truth paradigm, resulting partly from the democratization of media and communication in general. This has brought about a situation in which media audiences no longer acknowledge that some entities may hold superior knowledge on any given topic. As a result, scientists committed to rational argumentation are dismissed as irrelevant, and primacy is given to personal feelings and experience, so that an assertion is accepted as true if it "feels" true. This erosion of epistemological standards would appear to be a further instance of the phenomenon of "truth-subversion" [33], which is currently receiving considerable critical attention, and the current media landscape offers little scope for improvement.

On the other hand, if we move beyond the purely epistemological realm, the current findings also suggest that present-day distrust in experts is more than just confusion arising from a lack of criteria on what constitutes expert knowledge. Considered in socio-political terms, this evidence shows that suspicion of experts is often closely linked with distrust of the establishment and those in authority, variously grounded in political party rivalry, general anti-elitism or suspected financial corruption. In a social perspective, the present dataset provides evidence of the "distrust of expert systems" identified by Giddens [34] as a latent factor in late modern societies. Importantly, one of the consequences that Giddens ascribes to this distrust of authority is that individuals are increasingly likely to feel that they should make their own risk calculations, even though—particularly in cases such as COVID-19—they patently lack the expertise and information that might enable them to do so. During the pandemic, public trust/distrust in government has been found to have a strong impact on behaviour patterns in different countries [35]. If we try to look beyond the (real) confusion and disorganization that characterized public health policy and messages at the time, we can observe that this manifest distrust of "the system" bears traces of three potent driving forces: communicative overkill, attribution of profit motives and suspicion of elite knowledge institutions.

First, the constant stream of alarming messages, supposedly backed by expert authority, tends to give rise to fatigue in the public mind, "an 'exhaustion' with repeated series of threats about the danger of the 'next big killer' that results in a lack of risk perception" [11,36]. The mass media's role in this is clear. These media drive distrust by exposing the public to massive quantities of information about risk of which they would formerly never have been aware [37]. At the same time, they also enable the growth of public contestation of expert authority, and the rise of social media has driven us to a new level of information dissemination, which is faster and less controlled than ever before. One outcome of this is the massive circulation of an indiscriminate panoply of views, which produces confusion and, importantly, fatigue [9], a phenomenon that was found to be particularly acute during the COVID-19 pandemic, with grave consequences for people's health [38].

Second, we have seen that distrust was fueled in many cases by suspicion of "Big Pharma". This concurs with recent research on social media postings about infectious diseases that revealed considerable skepticism of the public health sector, and a widespread tendency to attribute ulterior motives to "big Pharma" and government collusion. In some cases, these notions were also linked to other conspiracy theories: as previous researchers have observed, some people seem to have a "general propensity towards conspiratorial thinking" [24], and seize upon inconsistencies or possible instances of collusion to confirm their habitual framing of social affairs [23]. In the case of health issues, these conspiracy theories may pose a real threat to societal wellbeing, particularly if they circulate widely to credulous or uneducated audiences. As Laurent-Simpson and Lo [11] put it: "the social construction of [health-related] risks (. . .) as products of an ultimately profit-

driven medicopharmaceutical complex saps public trust in the first-line defenses devised and advocated by the experts." The findings of the present paper echo these authors' observations that in social media forums "a clear sense of doubt is present about the likelihood of a non-corrupt science" [11]. As we can observe here, this phenomenon may have worrying consequences for public health.

Third, the theme of suspicion of experts takes on a particularly interesting political dimension in the particular context of the UK media in 2020. Rejection of "experts" and of elite knowledge systems in general was a notable characteristic of populist messages circulating in English-language discourse in the years preceding the Brexit referendum and its aftermath, mirroring parallel developments among Trump's supporters in the USA. Clarke and Newman [20] compellingly analyzed how suspicion of experts was integral to the Brexit-era conjuncture: in the words of Vote Leave campaigner Michael Gove, "I think people in this country have had enough of experts" [39]. This rejection of expert opinions may have been at least partly motivated by the failure of technocratic neo-liberal governments to address issues arising out of globalization in a way that failed to satisfy the demands of the disaffected or fire the popular imagination. Even more, according to Clarke and Newman [20]: "The revolt against 'expertise' in the moment of Brexit refracted questions of both class (antipathy to ruling elites, the very architects of austerity) and nation (expertise symbolized 'elsewhere'; international institutions, EU bureaucrats and those seeking to protect global free trade)." In the context of COVID-19, it should be noted that although the rejection of "expertise" in the Brexit period was initially associated with predictions concerning the economic or social sphere, universities and scientists were consistently associated with the Remain agenda. It seems quite likely that subliminal associations placed universities on the list of suspicious "experts" in the public mind. The Brexit-era Zeitgeist converged with the specifically British variety of anti-intellectual anti-elitism to undermine the credibility of scientific research. It is notable that when the commenters here countered "expert" knowledge, they had continuous recourse to what "we all know", showing evidence of a strong current at work to reframe anti-scientific stances as "common sense" [40]. It is a sign of the times that during the COVID-19 pandemic, suspicion of "experts" was a potent political force in public debate.

To sum up, this paper contributes to our knowledge of how important health issues are discussed in online forums. It has shown that the appeal to "expert" knowledge is no longer a foolproof means of guaranteeing that information is accorded importance in the public arena. Indeed, the status of the "expert" is increasingly problematized in public discourse. The social consequences of this undermining of expert knowledge systems have been discussed in the light of theoretical analyses concerning information overload, epistemological flattening, conspiracy theories, the post-truth paradigm and the populist mindset. In methodological terms, this paper has provided an innovative solution to the problem of social media data, showing how corpus-assisted discourse analysis can be applied to fragmentary textual data in order to establish patterns that are reproduced across large datasets.

The question remains as to how this situation could be addressed. Widespread distrust in authority reduces the impact of health messages, so we should assume that, conversely, trust in authority would be associated with receptivity to official messages. In parallel to this, where distrust of government is common, the mainstream scientific consensus is also likely to be less well accepted [41], but where people have confidence in government and establishment, they are more receptive to scientific information and comply with health policies. One message in this sense might be a call to politicians and establishment figures to behave responsibly, exercise transparency to rebuild trust and communicate risk in ways that are accessible and meaningful for the wider public. At the same time, experts could exercise greater transparency and provide stronger justifications for their pronouncements [42], and pharmaceutical companies could put procedures in place to make sure that safe and affordable vaccines are available for all [43]. Concerning the communication of science, it has been suggested that stronger scientific literacy could be

fostered in which the “social and conversational nature” of scientific knowledge production is promoted so that people can build informed trust in science and engage more actively with its epistemological and processual complexities [28].

In all of this, however, the very real difficulties of communicating complex information to the general public should not be underestimated. In his overview of the opposition to vaccination over the last two hundred years, Baxter [2] commented that “the complexity of the arguments involved in universal prophylactic vaccination programmes” frequently made it hard for health authorities to convey the benefits of vaccines to the general public. Discussing earlier controversies, he points out that “neither protection nor adverse events around pertussis or MMR could easily be discussed in the usual three minutes news slot”. If this is true, the situation is even more challenging in the current social media age in which information is habitually reduced to the size of a tweet or Facebook post. A further proposal would be to provide more effective educational programs including media literacy, basic scientific literacy, including notions of expert consensus [3], and basic principles of public health, including “vaccine literacy” [41]. However, the notion that better education on science and scientific consensus would be a panacea is problematic, not least because real consensus is sometimes lacking, and the competent authorities themselves often issue contradictory information when faced with an emergency.

In short, in the age of social media, proliferation of distrust of the medical and scientific communities has challenged the authority of health organizations. To combat this, health and other scientific professionals need to examine closely the user reception of public health representations, deconstruct the various counter-discourses that circulate, and explore practices that might help to rebuild trust among the population. More research along the lines of the present study is needed in order to obtain deeper insights into the reception of health messages and the proliferation of different types of information through interactive media. Systematic content analysis or big data techniques could be used to test these findings and explore the patterns that occur across larger datasets. Finally, it is important to point out that this dataset was collected during the period when the vaccines were being developed and trialed. It is therefore understandable that the vaccines inspired people with a certain degree of trepidation. It would be useful to replicate this study using data from a later phase in order to trace how trust evolves as real answers are provided to a pandemic and examine how people weigh the benefits of vaccination against the messages from its detractors.

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Appendix A. List of Mail Online Articles from Which Comments Were Scraped

Headline	No. of Comments	Date Published
1, “Israeli scientists say they are just WEEKS away from developing a vaccine which will beat coronavirus”	167	28 February 2020
2, “Australian scientists claim they’ve ALREADY developed a vaccine for coronavirus—but they can’t roll it out to people just yet”	197	13 March 2020

Headline	No. of Comments	Date Published
3, "‘I’m feeling great’: Mother of two becomes first person in the US to get injected with experimental coronavirus vaccine—but it won’t be ready for at least a year"	50	15 March 2020
4, "First patient will get an experimental coronavirus vaccine TODAY—but scientists warn it will be at least a YEAR before the jab could be rolled out to the rest of the world"	138	16 March 2020
5, "Coronavirus VACCINE that scientists claim can neutralise the deadly virus for at least a year could be approved for human trials ‘within months’"	171	2 April 2020
6, "Coronavirus death rate is SIX TIMES lower in countries that use the century-old tuberculosis BCG vaccine"	738	7 April 2020
7, "Coronavirus vaccine could be ready by AUTUMN, say Oxford University researchers behind major trial "	414	10 April 2020
8, "Coronavirus vaccine could be ready by September with an 80% likelihood it will work, says Oxford University expert leading research team"	695	10 April 2020
9, "UK will have to live with some restrictions until coronavirus vaccine is developed, say officials, as new survey reveals that nine out of 10 Britons are observing ‘stay home’ advice after 980 daily death toll "	995	10 April 2020
10, "Oxford University to begin tests of its coronavirus vaccine on humans NEXT WEEK in hope of having a jab ready for autumn"	330	15 April 2020
11, "Trials of a SECOND coronavirus vaccine set to begin in June as Imperial College London scientists move towards human testing after Oxford experiments begin tomorrow"	512	22 April 2020
12, "One of Britain’s first coronavirus vaccine volunteers reveals side effects could include flu-like symptoms and a fever that lasts several days as trials start today",	437	23 April 2020
13, "First coronavirus vaccine could be ready by September, head of China’s CDC claims"	175	24 April 2020
14, "World-leading Australian scientists say a vaccine may be ready for widespread use at the start of next year—and that’s under an ‘incredibly ambitious’ timeline"	13	29 April 2020
15, "Experts warn a coronavirus vaccine may not be available until 2036—despite Dr Anthony Fauci saying ‘hundreds of millions’ of doses could be ready as soon as January"	264	1 May 2020
16, "Italian researchers claim to have ‘the first vaccine in the world’ that kills the coronavirus and are now planning human trials as Health Secretary Matt Hancock admits a jab may NEVER be found"	249	6 May 2020
17, "Coronavirus vaccine hope as Oxford University’s experimental jab prevents the infection from penetrating the lungs in monkeys"	422	14 May 2020
18, "Doubts raised over Oxford coronavirus vaccine after ALL of the monkeys that took part in the trial are found to have contracted the disease"	491	18 May 2020
19, "Pharmaceutical giant AstraZeneca has capacity to make ONE BILLION doses of Oxford University’s experimental COVID-19 vaccine amid hopes it could be ready for September"	155	21 May 2020
20, "China’s coronavirus vaccine is deemed ‘safe’ and triggers an immune response in world’s first completed human trial of 108 volunteers—but it may not ‘neutralize’ infection, expert says"	34	22 May 2020
21, "Britain WILL get a coronavirus vaccine by September (if it works), says AstraZeneca CEO despite his lead scientist giving it only a 50% chance of success because COVID-19 could vanish before trials finish"	549	24 May 2020
22, "Hopes rise of a Covid-19 vaccine breakthrough as TWO trials in the UK and US show volunteers injected with experimental jabs have signs of immunity against the disease"	743	15 July 2020

Headline	No. of Comments	Date Published
23, “Could this conspiracy theory kill thousands? Disgraced British doctor Andrew Wakefield, who lost his licence for saying the MMR jab caused autism, is already at heart of a movement that says the pandemic is a hoax and NO ONE should have vac”	992	16 July 2020
24, “Hopes rise for a coronavirus vaccine ‘by Christmas’: First trial results of Oxford’s Covid-19 jab reveal it is safe and provokes an immune reaction that lasts for two months—as Chinese candidate also looks promising”	986	20 July 2020
25, “Bill Gates warns that multiple doses of any coronavirus vaccine may be necessary, schools could be closed until fall 2021 and says ‘serious mistakes were made’ by the US with the handling of COVID-19”	956	23 July 2020

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Article

Reader Comments Agentive Power in COVID-19 Digital News Articles: Challenging Parascientific Information?

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Abstract: The recent COVID-19 pandemic has triggered an enormous stream of information. Parascientific digital communication has pursued different avenues, from mainstream media news to social networking, at times combined. Likewise, citizens have developed new discourse practices, with readers as active participants who claim authority. Based on a corpus of 500 reader comments from *The Guardian*, we analyse how readers build their authorial voice on COVID-19 news as well as their agentive power and its implications. Methodologically, we draw upon stance markers, depersonalisation strategies, and heteroglossic markers, from the perspective of discursive interpersonality. Our findings unearth that stance markers are central for readers to build authority and produce content. Depersonalised and heteroglossic markers are also resorted, reinforcing readers' authority with external information that mirrors expert scientific communication. Conclusions suggest a strong citizen agentive power that can either support news articles, spreading parascientific information, or challenge them, therefore, contributing to produce pseudoscientific messages.

Keywords: digital news articles; reader comments; citizens' agentive power; parascientific genres; pseudoscience; COVID-19 information

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1. Introduction

1.1. Parascientific vs Pseudoscientific Information

In order to contextualise our research, it seems necessary to depart from some assumptions about two concepts that need disambiguation: parascience and pseudoscience. Scientists nowadays play a variety of roles related to the skills associated with scientific work. They often act as experts [1] on issues of social relevance in the media or at events with public impact, a practice we could name as parascientific. The issuing of judgements based on their expertise in a scientific field can help to shape public opinion or to guide the behaviour of citizens [2]. In this vein, scientific communication in general has undergone important changes over the last decades. Many scientists have begun to practice what is called *open science*, where “research materials are provided through an “open” (online) lab notebook, data collections are made available, and some scientists even blog about the research progress” [3].

Simultaneously, generalistic media, complying with their task of publishing news related to current scientific topics such as COVID-19, also issue parascientific information with a documented professional focus, relying on scientific data. This practice of journalists publishing scientific information can be said to have triggered parascientific genres that operate somewhere between expert discourses and popularizations. Some of these parascientific genres are popular news articles and their comment sections. We consider them parascientific and not just popularizations, and they are related to the ability for citizens to comment, adopting certain markers of scientific discourse. Comments are written in a space provided by the digital newspapers, in an attempt to improve audience loyalty [4], making readers feel protagonists as commenters. However, this phenomenon is also related to social networks, as happens with Facebook, where mainstream newspapers offer to follow their profiles, as is the case with *The Guardian*.

From this perspective, parascience is closely linked to digital news, as a result of several variables, the first one being the outburst of social networking that has allowed worldwide digital communication. The arrival of Web 2.0 technologies and social media networking have resulted in a paradigm shift, giving rise to the novel practice of produsage (producing plus using), where citizens not only use technically-mediated genres, but also produce information, or user-generated content (UGC) [5]. Indeed, the research community has claimed a shift in power to the benefit of users through the rise of a new “participatory culture”, where boundaries between production and consumption become blurry [6].

Another variable worth considering is the increasingly agentive role that citizens have undertaken in practically all areas of society, as a result of the current customer service society [7], which has empowered individuals by giving them a voice. This financial mercantilism of today’s postmodern society [8] has also permeated the digital news and media system, where readers and their comments have reached a new dimension. Hence, citizens now have the possibility to take part in an array of e-genres that deal with knowledge dissemination through comments they make on fields such as climate shift, medical discoveries, natural disasters, politics or global health, to name but a few.

Nevertheless, this practice of laypersons commenting on scientific news in digitally mediated newspapers can also lead towards a dangerous consequence: that of creating and spreading pseudoscientific information. The media are, at the same time, the main allies of science in their desire to disseminate news about relevant issues, but also their main enemies by giving shelter to pseudoscientific messages. Due to the great power of the media as disseminators of reality and guarantors of that which is included/excluded in the system, their responsibility is not a minor issue, as it can multiply the threats posed by pseudoscience [9].

Moreover, the media intoxication resulting from the dissemination of pseudoscience can lead to a normalisation of the phenomenon on a social scale, while at the same time establishing a false understanding of the problem. Thanks in part to the media complicity, pseudoscience, in its various manifestations, invades the social body and forms a dangerous scenario, which exploits the individual uncertainty of the liquid modernity [10] as well as the gap between expert knowledge and popular knowledge. In fact, many readers may be incapable of decoding information, since they lack references that allow them to make a free choice based on real knowledge.

As for the description of pseudoscience, three features are attributed to it [9]: it usually belongs to a discipline that is related to science; (2) it is not epistemologically warranted; and (3) its proponents try to create the impression that it is scientific. In addition, it manipulates the emotions of the public at large, such as hope or fear of the future [9]. The fact that pseudoscience has gained access to the media sphere reflects one of the main characteristics of our society today: its paradoxical component. This paradox can be seen in the parallel paths of science and pseudoscience. While science has reached goals as well as fulfilled objectives and expectations, pseudoscience opposes its own growth and development to the contemporary scientific boom, with an omnipresent sense of crisis [10,11].

1.2. New Discourse Practices of Citizens/Readers

Reader comments of a great range of media may support and spread positive news, but they can also challenge journalists and produce pseudoscientific messages, understood as a downgrading of scientific and parascientific knowledge because readers are laypersons and thus, supposed non-experts. Research has been conducted in many UGC genres such as online consumer forums and online reviews [12–14]. In consumer forums, readers reply to writers, turning into writers themselves as *writers* [13], since they hold both roles and they produce legitimate content. In addition to that, they do not challenge authors, since all the interactants have an equal, generically defined peer status, their common aim being to share opinions about services or products. Another, similar case, are technologically-mediated platforms among professionals, such as medical blogs, where interactants are experts; thus, readers and authors also hold a similar status, afforded by the genre and

its discourse community. Yet, it is not the case with digital news articles. In this genre, readers reply to news articles, showing a powerful agency [15], responding and at times challenging journalists who are professional writers holding documented information. The difference lies in that readers cannot qualify as journalists with expert knowledge, since the genre and the related discourse community [16,17] does not endow them with that status. This is the case with *The Guardian*, a mainstream newspaper addressed to lay people. In other words, it is the genre that provides its interactants with the status of experts or non-experts and, therefore, gives them authority or not.

At this point it is important to clarify how we regard the concepts of genre and discourse community. Following Swales [16], a genre comprises a set of communicative purposes that must be recognized by the expert members of the discourse community. This rationale shapes the structure of its discourse and influences and constrains choice of content and style. If we consider reader comments as part of the digital news article, described as a genre that produces true information, we are accepting one single discourse community behind, where content and style are accepted by all its members. Reader comments can respond to journalistic information through opinions, as long as readers accept this expert knowledge as true. However, this is not always the case. Commenters of news articles on health issues such as COVID-19 may reject writers as truth guarantors and at times challenge them, therefore, issuing pseudoscientific information. Besides, journalists, as members of the same discourse community, cannot accept commenters' opinions if these trespass the discursive boundaries set by the genre. This is why the limits of writers and readers' interaction in parascientific communication through the Internet may look eroded [18].

In Trench's [18] words, the Internet "is turning science communication inside-out" and, as a result, the boundaries between expert and non-expert science communication are "eroding". These boundaries have long been blurred by parascientific genres such as trade magazines [19] but also by scientific journalism in generalistic media. The COVID-19 pandemic has been an extraordinary, unprecedented situation, with citizens taking active roles on different aspects of this new illness, such as vaccines, prevention norms or government measures. In digital media news related to health issues such as COVID-19, readers accomplish the principle of shared knowledge only to some extent, since they can react to news in unexpected ways.

In view of this scenario, we asked ourselves which mechanisms could help COVID-19 news article commenters to write convincingly, challenging expert journalists and creating messages that can influence citizens. Since this kind of communication entails strong interpersonal discourse characteristics, two aspects seemed worth analysing in the construction of commenters' authority: authorial voice and content. The authorial voice usually takes stance markers that favour assertiveness and closeness to readers, such as self-mentions, but also other markers such as hedges, that mitigate a too strong stance [20]. Likewise, commenters can resort to boosters as grammatical enhancers, or attitudinals, which provide a subjective, persuasive shade, principally in the form of qualifying adjectives. They can also use external references in the form of impersonalisations, depersonalisations and heteroglossia [21] to produce comments with scientific, external support, imitating the scientific discourse and thus creating content. This is what we attempt to unveil through the current study.

2. Materials and Methods

2.1. What We Hypothesise

We hypothesise that readers may support but also challenge writers on COVID-19 related matters, construing an authorial voice that defies that of journalists who write about scientific issues. To do so, readers produce judgments and opinions, taking an active role as citizens in societal matters such as health, and having the possibility to influence other readers positively, but also in negative ways, contributing to rumours or false knowledge.

To this end, we would like to test the following two hypotheses:

HP1. Readers build their discursive authority through an authorial self-construction that responds and at times contests news article writers through assertiveness and also mirroring expert scientific discourse strategies.

HP2. Readers' authorial self-construction of authority may include closeness and distance pragmatic strategies [20], using stance markers, but also resorting to impersonalisation, depersonalisation or heteroglossic strategies, in an attempt to reduce an excessive personal assertiveness, thus projecting a more convincing authorial voice.

2.2. Methodology

2.2.1. Corpus Description

Our corpus collection was carried out from November 2020 to February 2021, and a sample of 100 news articles along with 500 reader comments were retrieved from the British digital newspaper *The Guardian* by accessing the social networking site Facebook. Our corpus collection has, at all times, been carried out following the University of Valencia Code of Good Practices in Research: (can be found at https://www.uv.es/hrs4r/Code_Good_Practice_Research.pdf (accessed on 10 September 2021)). We extracted our corpus through this networking site, which is massively used by all kinds of people, instead of collecting it from the digital *The Guardian* platform that is read by fewer citizens, at times only via subscription. With this decision, we tried to assure a more diverse number of commenters in the corpus. So, news articles dealing with the COVID-19 pandemic as well as their reader comments were selected. These comments contest the COVID-19 information of each article.

As regards the size of the corpora, the news articles data set contains 40,400 words and that of the reader comments contains 42,330 words. It is worth underlining that we have only focused on analysing the comments made by readers and, when needed for contrasting purposes, the information given by the article writer. As far as comments held among readers are concerned, these were excluded, since they are out of the scope of this research.

2.2.2. Framework of Analysis

The perspective followed in our analysis is eclectic and draws on the concept of discursive interpersonality [22], which addresses interpersonal communication—here of readers towards writers—from the viewpoint of discourse and not from that of genre. This viewpoint of interpersonal communication allows to transcend strict metadiscursive approaches [23] and acknowledges the use of lexico-semantic elements or discursive strategies dictated by each specific text. Therefore, it is the discourse of reader comments with concrete social conditions (the COVID-19 pandemic in general) that has enabled us to identify interpersonal discursive strategies, features and resources that shape interaction in particular ways. To analyse how readers construe their selves, we have resorted to Hyland's [23] stance markers, as well as to depersonalisation strategies: personifications, nominalisations, passive sentences, impersonal expressions + infinitive, and there + be clauses [21]. Finally, we have relied on heteroglossic categories, namely endorsement, attribution and distance [24], to complete the analysis.

An observational analysis has been the main methodological approach followed in this research, in turn supported by quantitative data. As for the procedure of analysis, it has been as follows: as shown in Figure 1 below, we have departed from the assumption that reader comments entail strong interpersonal characteristics, making readers construct their authority not only through their authorial voice, but also through content. The authorial voice is materialised through closeness and distance pragmatic functions, and these, in turn, through discourse strategies such as stance [23], depersonalisation [21] and heteroglossia [24]; all of them are realised through different lexico-grammatical uses:

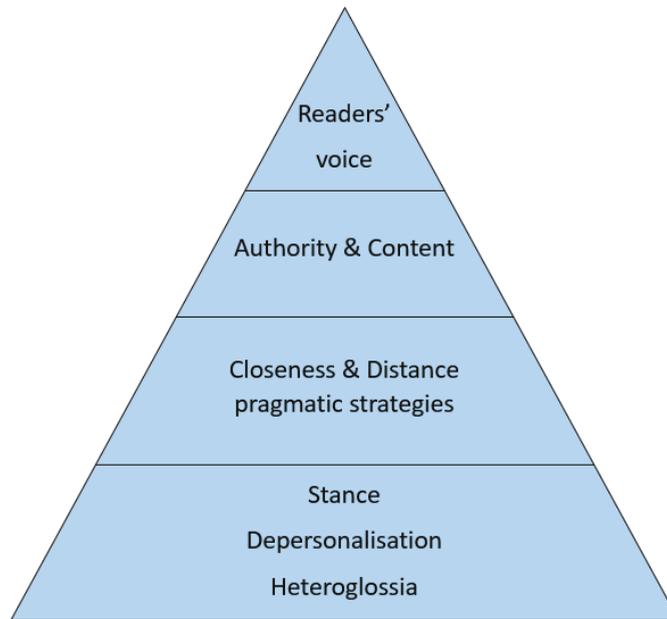


Figure 1. Readers' authorial self-construction through closeness and distance pragmatic strategies.

In order to have a full picture of the readers' discursive self-construction, we also found it necessary to analyse that of the journalists as writers, so both discourses could be compared and visualized, as they are shown in our Section 3.

The Ant.Conc 3.5.8. concordancing tool has been used to work out the absolute frequency of the different closeness and distance pragmatic strategies found in the two corpora analysed as well as their lexico-grammatical uses. To do so, we have followed the categories and linguistic realizations previously dealt with in the literature [20,21,25–27]. Due to the constraints imposed by the AntConc Software to identify all the strategies considered in the analysis, some of them have been manually counted. It is also important to point out that, as both corpora are inevitably of a different lexical density, the absolute corpora are also of a different lexical density. The absolute frequency of each interactional marker and their lexico-grammatical realizations have, therefore, been divided by the total amount of words contained in each data set and then computed per 1000 words, which has been regarded as a conventional way of standardising results of corpora of unequal size.

3. Results

This section is devoted to describe the most relevant findings, illustrated through different examples drawn from the corpora selected for the research.

Concerning closeness and distance pragmatic strategies, Hyland [28] defines closeness as "a writer's control of those rhetorical features that display both authority as an expert and a personal position towards issues in an unfolding text". In other words, this pragmatic strategy is intrinsically associated with promoting subjectivity, visibility and friendliness. Nevertheless, given that reader comments not only trigger strong interpersonal characteristics but also specific content, we have considered that closeness does not only reinforce readers' authority through stance markers such as first-person singular pronouns, but also through attitudinals such as adjectives, verbs, etc. Following Hyland's model of stance [23], the markers and lexico-grammatical realisations that have been selected for the analysis are the following: a) boosters (e.g., emphatic adverbs and phrases); b) attitudinals (e.g.,

attitudinal adjectives, verbs, and adverbs, deontic verbs, exclamations); and c) self-mention markers (e.g., first-person singular pronouns).

In regards to distance, [20] (p. 78) describes this pragmatic strategy as “a specific way through which authors project authority by means of diverse linguistic choices including objective and/or depersonalised realisations with the deliberate intention to show credibility”. Therefore, in sharp contrast with closeness, distance can be linked to objectivity, invisibility and professionalism. In a similar vein, distance pragmatic strategies can characterize authorial voice as well as content, as manifested in the use of hedges or inclusive first-person plural pronouns, depersonalizations and heteroglossic markers, which mirror the conventions of scientific discourse. Drawing on stance markers [23], depersonalisation strategies [21] and heteroglossic markers [24], the following resources and lexico-grammatical realizations of closeness and distance pragmatic strategies have been considered for the analysis: a) hedges (e.g., approximators, modal verbs, semi-auxiliary verbs, conditionals, probability adverbs, verbs, adjectives, nouns, concessive linking words); b) first-person plural pronouns (e.g., inclusive ‘we’ forms); c) depersonalization markers (e.g., personifications, agentless passive sentences, nominalisations, impersonal passive constructions, there + be clauses); and d) heteroglossic markers (e.g., endorsement, attribution and distance). Table 1 below shows a quantified evidence of how total closeness and distance pragmatic strategies are distributed in the two corpora analysed.

Table 1. Total distribution of closeness and distance pragmatic strategies in the two corpora.

Total Distribution	Writer News Content		Reader Comments	
	AF n/40,040	RF * 1000	AF n/42,330	RF * 1000
Closeness	131	32.42%	220	61.50%
Distance	274	67.58%	163	38.50%

AF stands for ‘Absolute Frequency’; RF stands for ‘Relative Frequency’. * Due to the different lexical density in the two corpora analysed, the absolute frequency was calculated per 1000 words in order to standardize the results obtained.

As seen in Table 1 above, the total occurrence of closeness pragmatic strategies in the reader comments data set outnumbers those related to distance. Nevertheless, the frequency of the latter is clearly higher in the news articles corpus. At first sight, these general quantitative findings show that news articles written by journalists who provide information on COVID-19 and comments made by readers towards the content seem to follow the genre conventions. On the one hand, journalistic discourse and the news article genre have been traditionally characterized by the canon of objectivity and impartiality, encouraging the use of distance pragmatic strategies. On the other hand, given the colloquial linguistic nature of reader comments, a higher occurrence of closeness pragmatic strategies is expected, as the table shows. Despite these general findings, we have found it necessary to carry out a more thorough analysis of the different interpersonal markers, through which these two pragmatic strategies are realized along with their different lexico-grammatical uses to study whether there is some sort of linguistic variation between both data sets that may confirm or refute our hypotheses. Results in the use of closeness and distance pragmatic strategies, their categories and their lexico-grammatical realizations are shown in Tables 2 and 3 below:

Table 2. Frequencies in the use of closeness pragmatic strategies in the two corpora.

Closeness Pragmatic Strategies	Writer News Content		Reader Comments	
	AF n/40,040	RF * 1000	AF n/42,330	RF * 1000
Boosters	-	-	11	2.59%
Emphatic adverbs (e.g., actually, really, certainly, etc.)	-	-	7	1.65%
Emphatic phrases (e.g., it is clear that, in fact, indeed, etc.)	-	-	4	0.94%
Attitudinals	131	32.42%	189	44.64%
Attitude adjectives (e.g., interesting, terrible) best)	81	20.04%	88	20.7%
Attitude verbs (e.g., know, guess, feel, think, etc.)	33	8.16%	20	4.72%
Attitude adverbs (e.g., fortunately, personally, etc.)	14	3.46%	48	11.3%
Deontic verbs (e.g., must, need, should)	3	0.74%	20	8.22%
Exclamations	-	-	13	3.07%
Self-mention Markers	-	-	20	4.72%
First-person singular pronouns (e.g., I, me, my, etc.)	-	-	20	4.72%
Total	131	32.42%	220	51.97%

AF stands for 'Absolute Frequency'; RF stands for 'Relative Frequency'. * calculated per 1000 words.

This preliminary quantitative analysis reveals that both corpora show a variation in the use of stance, depersonalised and heteroglossic markers. In other words, the corpus of news articles on COVID-19 pandemic written by journalists include implicit self-mention markers such as depersonalisation strategies and heteroglossic markers to a greater extent than readers do in their comments. On the contrary, the occurrence of attitude markers and explicit self-mention markers is higher in reader comments. These findings support the idea that journalists and commenters follow different communicative constructions of their authorial voices, with different effects on the readership. This is clearly manifested in the objectiveness and impartiality through which journalists write on health issues such as COVID-19, that distinctly promote the use of depersonalised and heteroglossic markers. Contrarily, stance markers predominate in the reader comments, as a possible result of the colloquial modality of this communicative context. Notwithstanding this, readers do not seem to overlook the use of depersonalised and heteroglossic markers, when making their comments, albeit with much lower frequencies than those of the writer news articles. This is one of the chief reasons why we have found it convenient to carry out an analysis of a more qualitative nature with the two corpora, that may aid to develop these preliminary findings.

Even though the news articles corpus is not deprived of stance markers such as attitudinals, through which journalists provide a subjective view of the informational content, these are frequently combined with stance markers such as hedges as well as with a high frequency of heteroglossic markers, leading to a clear depersonalization of the journalistic discourse. By the same token, stance markers such as attitudinals, boosters and first-person singular pronouns used by readers also appear in combination with hedges, implicit self-mention markers and heteroglossic markers, seemingly producing a more distant, objective discourse. In the following paragraphs, we offer some examples drawn from the two corpora, to better illustrate our observations:

Writer News Content

1. Despite this, the arrival of the Oxford/AstraZeneca vaccine would undoubtedly be a game-changer, said Helen Buckingham, director of strategy at the Nuffield Trust. "Then staffing will become the primary constraint," she added [. . .]
2. If a new virus sounds scary, a new mutating virus sounds scarier still. In Kent in September, scientists now believe, somebody with Covid was the unlucky first person to pass on a variant form of the coronavirus that is maybe as much as 70% more transmissible than the version we have been used to [. . .]

Reader Comments

3. I'm reassured that the current vaccines *would* still fight B117 variant [. . .]
4. [. . .] The media *seems* wedded to narrow oversimplification of vaccine trial data. *They* never emphasise the critical point that all of these vaccines currently *seem* to offer protection against serious illness [. . .]

Table 3. Frequencies in the use of distance pragmatic strategies in the two corpora.

Distance Pragmatic Strategies	Writer News Content		Reader Comments	
	AF n/40,040	RF * 1000	AF n/42,330	RF * 1000
Hedges	91	22.5%	82	19.3%
Approximators	10	2.47%	1	0.23%
Modal verbs	24	5.94%	26	6.14%
Semi-auxiliary verbs	9	2.22%	7	1.65%
Conditionals	6	1.48%	16	3.77%
Probability adjectives, nouns, adverbs and verbs	13	3.21%	9	2.12%
Concessive linking words	29	7.17%	23	5.43%
Self-mention Markers	13	3.21%	47	11.1%
First-person plural pronouns (inclusive 'we' forms)	13	3.21%	47	11.1%
Depersonalisations	90	22.27%	13	3.07%
Personifications	20	4.95%	-	-
Agentless passive sentences	53	13.1%	8	1.88%
Nominalisations	10	2.47%	2	0.47%
There+be+clauses	7	1.73%	3	0.70%
Heteroglossic Markers	80	19.8%	21	4.96%
Dialogic contraction: proclaim-endorsement	34	8.14%	6	1.41%
Dialogic expansion: attribution-acknowledge	7	1.73%	8	1.88%
Dialogic expansion: attribution-distance	39	9.65%	7	1.65%
Total	274	67.82%	163	38.50%

AF stands for 'Absolute Frequency'; RF stands for 'Relative Frequency'. * calculated per 1000 words.

In example (1), the writer of the news article uses an attitudinal adverb (undoubtedly) in the form of a stance marker to provide their own subjective view towards information on the Oxford/AstraZeneca vaccine. In spite of this fact, several distance strategies realised through hedges (Despite this, would) or even the use of an attributional marker (said Helen

Buckingham, . . .) through which the writer literally reproduces the words of a third person to support this information, helping them to disassociate the proposition uttered from the text's internal authorial voice, as seen in the aforementioned attitudinal adverb, leading to depersonalisation. The same interpretation can be applied to example (2) in which attitudinals (scary, scarier) are used by the writer to offer their view on a variant form of the coronavirus. Even so, this stance is depersonalised by means of grammatical realisations acting as hedges, as seen in the semi-auxiliary verb (sounds) to attenuate the opinion conveyed. This depersonalisation is also reinforced through an endorsement strategy (In Kent in September, scientists now believe . . .), in which the writer's proposition is supported by making reference to external sources to prove the information transmitted.

In example (3), the explicit self-mention marker in the form of a first-person singular pronoun allows the reader to provide their thoughts on the vaccines to fight the B117 variant. The modal verb (would) acting as a hedge attenuates the implication of the reader toward the opinionated information. Example (4) deserves particular attention, in which we can perceive how the reader makes use of stance markers in the form of attitudinal nouns and adjectives (oversimplification, critical) to put forward their view about trial data on vaccines. Nevertheless, the recurrence to heteroglossia by means of attributional makers referring to a third person (media, they) together with the use of a semi-auxiliary verb (seems) perform a mitigating/attenuating effect, allowing readers to distance themselves from the opinion stated and consequently making their discourse more depersonalised.

No examples of boosters were found in the writer news content. Some relevant examples on boosters drawn from the reader comments corpus are shown below:

Reader Comments

5. [. . .] I certainly won't be taking the vaccine. *It's been rushed* and *there's no guarantee* it will be effective if the covid19 virus mutates [. . .]
6. [. . .] the current phase III trials *are not actually set up* to prove either [. . .]

In example (5), the reader includes in their comment a booster realized through an emphasising adverb (certainly) to give prominence to their personal objections to get vaccinated. Nonetheless, this type of booster seems to be depersonalised in the adjacent sentence by adding both an agentless passive construction (*It's been rushed*) and a there + be clause (*there's no guarantee*). Something similar occurs in example (6) where the reader includes another emphasising adverb (actually) to stress their opinion on the information given in the article on vaccine trials. Nevertheless, this is inserted within an agentless passive sentence (*are not actually set up*).

As for the use of attitudinals, the following examples extracted from both data sets illustrate our findings:

Writer News Content

7. Against the background of rapidly rising infection rates, Boris Johnson's abysmal public rating appears to have bottomed out. According to the latest Opinium poll for the Observer [. . .]
8. [. . .] The results, reported in Nature Medicine, suggest the variant's key mutation, known as E484K, does not dramatically undermine the vaccine's protection [. . .]

Reader Comments

9. *Maybe we should add* sore throat to the list of symptoms requiring isolation and a test then; just a thought [. . .]
10. [. . .] *Most members of the public believe* that a vaccine against Covid.19 will prevent infection and save lives. Unfortunately, that is a very naïve belief *as Dr. Peter Doshi explains* in this publication by the peer-reviewed medical trade journal BMJ [. . .]
11. [. . .] This is brilliant news, yet *we must be cautious* as still early but any negativity is bonkers [. . .]

Examples (7) and (8) reveal how the journalists include attitudinals to provide their stance towards the informational content, such as intensifying adjectives and adverbs

(abysmal, dramatically). However, by means of both an attribution marker (According to the latest) and an endorsement strategy (The results, reported in Nature Medicine), these writers appear to distance themselves from the proposition conveyed.

In example (9), the reader includes a deontic verb (should) to give advice on the symptoms caused by COVID-19 that are in need of isolation. Yet, by adding the probability adverb functioning as a hedge (maybe) followed by the inclusive pronoun (we), the reader's opinion appears to be highly minimised. In addition, when introducing (just a thought) at the end of the comment, the dialogic space seems to be opened to further comments from the expert writer or from other readers. Example (10) is also worth commenting. In this case, the reader makes use of both an attitudinal adverb (unfortunately) and an attitudinal adjective (naïve) to provide their stance towards the role played by vaccines to save lives. Despite this, it can be observed that he/she adds an attributional marker (as Dr Peter Doshi explains ...), through which the writer seemingly distances himself from the proposition uttered, making their intervention more depersonalised. Finally, in example (11) attitudinals are also used (brilliant, cautious) to refer to the news that Moderna will show positive results by the end of 2021. Nevertheless, these stance markers change in the second part of the comment, in which the reader adds the collective pronoun (we), in an attempt to protect their own space and avoid responsibility.

The ensuing examples give evidence of the results yielded on the use of self-mentions:
Writer News Content

12. [...] The UK is not the only country with B117 cases. It may be because we do more genome sequencing than others that we have picked up so many [...]
13. [...] Moderna has agreed to provide the US with 100 million doses, with an option to buy 400 million more [...]
14. [...] Devolved nations were advised to bring forward their own national lockdowns [...]

Reader Comments

15. [...] Not my opinion this is *what the science is telling us* and is *backed up by 12-month experience* now in places like Australia and NZ [...]
16. [...] *Our* body's internal defence mechanism works well when *we* follow the natural path [...]
17. [...] Yes *the science now is different and more advanced* from previous pandemic in the past but this was rushed in my opinion to risk it [...]

As observed above, the news articles include a higher occurrence of implicit self-mentions markers through depersonalisation strategies, such as the use of a collective pronoun (we) in example (12), the use of a personification (Moderna) in example (13) and a passive agentless sentence in example (14). These strategies reflect the specific genre conventions of the news article, characterized by distance, objectivity and professionalism.

Even though the reader comments include explicit self-mention markers such as the use of first-person singular pronouns, this personal opinion is mitigated by means of an attributional marker (what the science is telling us) as reflected in example (15). We can also notice the use of inclusive pronouns (our, we) in example (16), as well as passive constructions (example 17). By using all these types of depersonalised markers, the reader's view is highly attenuated, giving room for alternative opinions that other readers may have in mind.

Finally, in relation to heteroglossic markers, findings drawn from our quantitative analysis revealed that the news articles include a higher occurrence of these markers due to the genre conventions. Despite this, the observational analysis indicates that some heteroglossic markers are used to back up reader comments towards the information provided by journalists. Examples drawn from both data sets may shed some light:

Writer News Content

18. [...] In the UK, the NHS on Saturday revealed that a further 161 people who had tested positive for covid.19 have died [...]

19. [. . .] Earlier the UK health minister Edward Argar acknowledged there would be a need for booster shots [. . .]
20. [. . .] More than 1 billion people could be immunised against coronavirus by the end of next year with shots from the first two companies to reveal positive results, after the latest vaccine was shown in trials to have an efficacy of nearly 95% [. . .]

Reader Comments

21. [. . .] The fact that *they have embarked on postcode testing* in some areas shows the level of concern about the SA variant [. . .]
22. [. . .] Does it protect against severe cases of Covid? Hospitalisation and so on? Yes, *according to data*. Then it's as good as it gets. The rest is media noise [. . .]
23. *Bill Gates is on video record stating it takes FIVE YEARS to develop and test a vaccine for maximum effectiveness and SAFETY. These guys have NO IDEA what the long term side effects on the human body might be. I'm just . . . wow* [. . .]

In example (18) the writer makes reference to the findings revealed by the NHS, which is an instance of endorsement. An attributional marker can be seen in example (19), in which the writer makes an explicit reference to the UK health minister. Lastly, in example (20), the writer also resorts to the use of an endorsement strategy, as it is the case with the results of the vaccines shown in trials.

In example (21), an endorsement strategy is used to support the opinion towards the SA variant. The rhetorical questions made by the reader in example (22) are supported by an attribution marker (according to data). In the last example (23) another attributional marker (Bill Gates . . .) is included to support the opinion on the side effects Moderna may have throughout time (These guys have no idea what . . .). Once more, heteroglossic markers are of great help for readers to avoid responsibility towards the opinions introduced through their comments.

In order to conclude this Section 3, we can say that after comparing both corpora data sets, journalists in their news articles resort to a depersonalized and heteroglossic style to a greater extent than readers in their comments, complying with the genre conventions concerning impartiality and objectivity. Oppositely, readers show a stronger stance in their comments than journalists, not only with an important use of closeness strategies made of abundant self-mentions and attitudinals but also with some distance strategies, using hedges. Besides, depersonalisations and heteroglossia also appear in reader comments, even though to a lesser degree than in news articles. However, when observed as a whole, reader comments show a greater amount of external support strategies, in the form of scientific quotations or references, than that of stance strategies.

4. Discussion

As our findings reveal, readers' authority construction is realised through closeness pragmatic strategies in the form of stance markers, mostly self-mentions and attitudinals, surpassing the use that writers of news articles make of these strategies. A subjective dimension is, thus, favoured. Nevertheless, readers also resort to frequent distance strategies in the form of depersonalisation and heteroglossic markers, which may appear intertwined with stance markers. Very importantly for our study, reader comments seem to contain more external support references than article news do, therefore, strategically reinforcing readers' authority. This combination of stance markers, depersonalization and heteroglossic strategies aids to build a powerful authorial voice that projects assertiveness and closeness, together with the authority that depersonalization provides [20], deploying a strong persuasive power. As far as content is concerned, the reader comments in our study contain information on COVID-19 that can either be in line with the news article, thus reinforcing its positive effect on other readers, or contest what documented journalists say, therefore, entailing a possible negative effect that may contribute to creating pseudoscientific messages. What follows is a detailed discussion of how reader comments authority is built,

aided by the different discursive strategies and including a reference to the content, labelled for each comment as *supporting* or *challenging*:

Concerning hedges as a stance category, reader comments reflect the use of some attenuating realisations, not only through modal verbs and conditional sentences, but also by addressing propositional content, sharing the discourse conventions of expert journalists. Readers appear to use hedges to strategically attenuate responsibility over their opinions, therefore, not openly invading the news writer's personal space [29,30]. Hedges may also appear in combination with a strong, subjective authorial self-mention or with depersonalisations:

3. I'm reassured that the current vaccines *would still* fight B117 variant [...] SUPPORTING COMMENT.

4. [...] The media *seems* wedded to narrow oversimplification of vaccine trial data. *They never emphasise* the critical point that all of these vaccines currently *seem to offer* protection against serious illness [...] CHALLENGING COMMENT.

As for attitudinal markers, they are frequent in the reader comments, especially in the form of qualifying adjectives or adverbs as well as adjectival and noun phrases. Through these markers, readers provide closeness and subjectivity [20], something aided by this type of discourse, characterized by concise messages and a colloquial modality [29–32], where attitudinals are bound to prevail:

10. [...] *Most members of the public believe* that a vaccine against Covid.19 will prevent infection and save lives. Unfortunately, that is a very naïve belief as Dr. Peter Doshi explains in this publication by the peer-reviewed medical trade journal BMJ [...] CHALLENGING COMMENT.

11. [...] This is brilliant news, yes *we must be cautious* as still early but any negativity is bonkers [...] SUPPORTING COMMENT.

22. [...] Does it protect against severe cases of Covid? Hospitalisation and so on? Yes, according to data. Then it's as good as it gets. The rest is media noise [...] SUPPORTING COMMENT.

Taking into account the aforementioned colloquial nature of reader comments, the same interpretation is valid for self-mention markers, especially first-person singular pronouns. As the findings have yielded, this stance marker is more frequent in reader comments and non-existent in the news article corpus:

3. I'm reassured that the current vaccines *would still* fight B117 variant [...] SUPPORTING COMMENT.

5. [...] I certainly won't be taking the vaccine. It's been rushed and *there's no guarantee it will be effective* if the covid19 virus mutates [...] CHALLENGING COMMENT.

15. [...] Not my opinion *this is what the science is telling us* and is *backed up by 12-month experience* now in places like Australia and NZ [...] SUPPORTING COMMENT.

23. Bill Gates is on video record stating it takes FIVE YEARS to develop and test a vaccine for maximum effectiveness and SAFETY. These guys have NO IDEA what the long-term side effects on the human body might be. I'm just ... wow [...] CHALLENGING COMMENT.

The use of first-person plural pronouns in reader comments deserves special attention. Indeed, readers seem to resort to an inclusive "we/us", behind which they seem to hide, so as to collectivize the utterance authorship and its related responsibility:

9. Maybe *we should add* sore throat to the list of symptoms requiring isolation and a test then; just a thought [...] SUPPORTING COMMENT.

11. [...] This is brilliant news, yes *we must be cautious* as still early but any negativity is bonkers [...] SUPPORTING COMMENT.

15. [...] Not my opinion *this is what the science is telling us* and is *backed up by 12-month experience* now in places like Australia and NZ [...] SUPPORTING COMMENT.

As for impersonalisations and depersonalisations, their use is central in reader comments as a whole, and importantly enough, they could also be regarded as a kind of attenuation strategy, in tune with what [33–35] refer to as impersonalisation, shields and

depersonalisations, respectively, thus giving a positive effect to the authorial image. Attenuation has been traditionally understood as a minimization of both the illocutionary force and the roles of participants in order to be effective in social communication and manage social image [36,37]. However, according to these linguists, depersonalised markers such as inclusive pronouns or agentless passive sentences do not seem to diminish the illocutionary force of the speech act—in our study, comments in the form of opinions. Something similar occurs with the use of agentless passive sentences. By means of both grammatical uses, readers resort to external support for their comments, helping the personal enunciator to make them invisible, thus producing a more distant, expert-like discourse, which is a powerful tool to convince other readers:

4. [...] *The media seems wedded to narrow oversimplification of vaccine trial data. They never emphasise the critical point that all of these vaccines currently seem to offer protection against serious illness* [...] CHALLENGING COMMENT.

6. [...] *the current phase III trials are not actually set up to prove either* [...] CHALLENGING COMMENT.

10. [...] *Most members of the public believe that a vaccine against Covid.19 will prevent infection and save lives. Unfortunately, that is a very naïve belief as Dr. Peter Doshi explains in this publication by the peer-reviewed medical trade journal BMJ* [...] CHALLENGING COMMENT.

21. [...] *The fact that they have embarked on postcode testing in some areas shows the level of concern about the SA variant* [...] CHALLENGING COMMENT.

22. [...] *Does it protect against severe cases of Covid? Hospitalisation and so on? Yes, according to data. Then it's as good as it gets. The rest is media noise* [...] SUPPORTING COMMENT.

23. *Bill Gates is on video record stating it takes FIVE YEARS to develop and test a vaccine for maximum effectiveness and SAFETY. These guys have NO IDEA what the long term side effects on the human body might be. I'm just ... wow* [...] CHALLENGING COMMENT.

Summing up, as our results show, reader comments reveal a twofold nature in building authority, referring to discourse and content. On the one hand, from a strictly discursive viewpoint, a strong authorial self-construction is shown, enacted by closeness strategies that include self-mentions and attitudinals, creating an assertive persona. Likewise, distance strategies made up of depersonalisations, impersonalisations and heteroglossia, acting as attenuators that mirror scientific discourse conventions are importantly used. These results confirm what discursive interpersonality [22] claims, transcending conventional metadiscursive approaches [23] and showing lexico-semantic realisations and strategies dictated by each specific discourse. On the other hand, from a content viewpoint, reader comments contain information that is not guaranteed to be expert knowledge, since readers are not endowed with this power by the news article genre. As a result, reader comments are either in line with news article information on COVID-19, disseminating a positive effect, or contain some challenging information, frequently supported by external, not always scientifically accredited sources, which can influence other readers, spreading possible pseudoscientific information.

5. Conclusions

The findings drawn from our study lead us to interpret that, as in other Web 2.0 communication platforms, digital news article readers are now empowered with an agentive role as news consumers [36,37]. This has paved the way for numerous changes in the production and circulation of information, since the reader can now be considered a producer of texts and information [38]. In these participatory journalism cultures, engaging the public is assumed to assist journalists in “telling stories more honestly” [39]. This means that news is no longer a finished project that claims exclusive access to the truth [15]. In this vein, audience participation is seen as a new agency that signals a shift in power in favour

of social agents [40], as well as a challenge to journalists, who so far have been gatekeeping power and media monopoly in “defining social realities” [15] (p. 23).

Following our analysis and results, it seems that our two hypotheses can be confirmed. Regarding the first one, our results prove that readers build their discursive authority through a strong authorial self-construction, creating an interaction with journalists that contests them at times and that challenges the conventional role of news article readers as audience. These results contravene the principle of *recipient design* [38], since the digital news article genre was fundamentally meant to allow readers to give opinions but not necessarily to let them create content that could influence other readers in ways that could harm their wellbeing.

As for the second hypothesis, and also according to our results, readers’ authorial self-construction includes closeness and distance pragmatic strategies [20] using stance markers and yielding a subjective and friendly discourse that can be very persuasive because it shares a colloquial language that other readers may recognize and accept as reliable. However, they also importantly resort to depersonalized and heteroglossic resources, meant to project a more convincing authority, based on external, scientific evidence, mirroring the discourse conventions of scientists.

It is needless to say that further research that analyses from a similar perspective a more extensive body of digital news articles and reader comments on matters of paramount importance for citizens would be required to extract more solid conclusions. However, our results already suggest a partial change of the readers’ role in the digital news article, partly because this technologically mediated genre has allowed readers to make comments, in an attempt to keep their loyalty. As a result, citizens feel entitled to produce knowledge information and to contest documented news article writers, something that endows them with a new power status in this participatory journalism. Our results seem to be in line with what [15] claims to be telling stories more honestly, with news articles not being a finished project until readers complete them with opinions and content. Parascientific communication might thus have turned inside-out [18], showing a positive dissemination of scientific knowledge where citizens can openly intervene and reinforce it with their opinions but also entailing dangerous implications when readers resort to content that may be pseudoscientific.

Although most media make an effort, with varying results, to disseminate parascientific information that provides citizens with true knowledge, some kind of defence against the spread of pseudoscientific messages seems necessary. Although it is a complex topic that entails ethical aspects dealing with citizens’ freedom of expression, and also with public wellbeing and health, parascientific practitioners might consider acting as gatekeepers and deploying mechanisms that can stop pseudoscience [2]. As mentioned above, this phenomenon of pseudoscience may be related to the social turmoil our society is going through [10], in which many people take seriously what lay people write about health issues, persuaded through a combination of discursive assertiveness and closeness, as well as an imitation of what scientific or parascientific writers would express in terms of content, impersonal style and external references. Concerning the question posed in the title, about a challenge of reader comments to parascientific information in news articles, it seems that some possibility exists, in light of our findings. Undoubtedly, ignorance is a breeding ground for pseudoscience so to counteract this ignorance and defend parascience, practitioners should learn from the discursive strategies that commenters use. Besides, an important tool is educational action, which can take place in the various science subjects at school, where the difference between science, parascience and pseudoscience should be addressed.

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Article

Scientific Stylisation or the ‘Democracy Dilemma’ of Graphical Abstracts

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Abstract: The need for more democratic models of interaction between scientists and non-expert audiences, the current commodification of research and the advancements of digital affordances have recently given rise to new online genres for science dissemination, such as the graphical abstract, increasingly demanded by high-impact journals despite its uncertain function. In this paper, I examine the problems posed by this hybrid genre as to the implementation of dialogical and more democratic models of science dissemination; namely, inferential confusion of concepts and narrative sequences, trivialisation and overall interpretive complexity, all of them caused or affected by visual stylisation. After scrutinising over 1000 graphical abstract samples from science blogs, research networks and random finds published in specialised high-rank international journals, I provide a taxonomy of stylisation and make the case for the explicit visual literacy training of students and scholars, as well as for a higher level of specification in the guidelines for potential authors of scientific journals.

Keywords: graphical abstracts; genre hybridity; stylisation; interpretive complexity; visual literacy

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1. Introduction: The ‘Democratic Turn’ in Science Dissemination. Is It Truly So?

Digital affordances and the pursuit of more democratic paradigms of science dissemination have introduced new discursive practices in academic discourse. Today scholars are encouraged to step down from their ‘ivory towers’, attract audiences other than experts and communicate with them directly, without the mediation of science journalists. The so-called ‘general public’ is not so ‘general’ or homogeneous anymore and may be composed of experts from other fields as much as laypeople. Thus, the idea that the public are untrained in scientific matters and therefore easily persuadable and in need of content simplifications and popularisations, as the deficit model of science dissemination has traditionally held, does not always apply, and even if it did, more dialogic models of dissemination are underway. Stocklmayer [1] documents the existence of more dialogic and participative models that listen attentively to the citizenship’s demands and criticisms, allow the exchange of views between scientists and non-experts, and the joint negotiation of meanings and research agendas. For example, PETA (People for the Ethical Treatment of Animals)¹ is launching an intense online campaign against the experiments conducted on marmosets by scientist Margaret L. Walker at the University of Massachusetts to investigate the absence of menopause among those primates, supposedly subjected to abusive and unnecessary cruel treatments in the laboratory. These facts have been alleged and brought to light by many U.S. pro-animalist activists and groups, whose voices are gaining quite an extensive presence online. Nowadays audiences want to know where their tax money goes, what type of scientific research and projects it is funding and with what results, and to have a say in research policies and courses of action, formerly opaque. They demonstrate actively against research initiatives that they deem pointless or unethical and become ever more visible through associations, ad hoc websites and social media.

Among other recent research genres, typical texts and interaction outcomes of this change in paradigm are science café sessions (usually organised by universities and research

centres to foster close contact with scientists), science blogs of individual or institutional creation and visual abstracts (i.e., either graphical or videotaped), which are by-products of computer-mediated communication. Bimodal (i.e., verbal and graphical) and multimodal abstracts (i.e., simultaneously verbal, graphical, voiced, or filmed with or without sound) are increasingly demanded by specialised high-impact journals and often displayed on YouTube or in journals' private video channels, separate from their hosting articles so as to be appreciated per se, as pieces with their own scientific and artistic value.

Graphical abstracts (henceforth GAs), which constitute the genre object of study in this article, are one of the two types of visual abstracts—the other one being video abstracts. GAs are also known as 'TOC (table of contents) images' and have been mistakenly thought to originate from Elsevier's 2010 'article of the future' project [2], while its true origin is to be related with the spontaneous fusion of three informative and promotional genres: the emblem, widely employed from the XV to the XVIII centuries, and the current infographic and advertising billboard [3].

The emblem, whose Greek name meant 'embossed ornament' or 'what is framed', consisted in an image (usually the portrait of a saint or some other prominent figure), framed by a motto above, frequently in Latin, and a textual commentary or brief legend at its foot. Its purpose was to provoke self-reflection on concepts, often allegorical, and biographies outstanding for their moral quality. Infographics display easy-to-understand images with some graphically dynamic components (e.g., vectors such as arrows or lines) that indicate the reading path (top-to-bottom, left-to-right, etc.) and confer the composition in a diagrammatic format which is very useful to explain processes or procedures. Last, billboard advertisements normally use a single static image taking up the whole promotional space with a minimum of verbal text (some slogan, the brand's name, or both) and sometimes none if the advertising brand is recognisable from the image alone.

Research on GAs has up to now addressed issues such as the dilution of genre moves and their effect on community boundaries [4], redundancy with the verbal text and rhetorical moves [5], media and discursive hybridity, emotion, and emergent scientist roles [6], authors and editors' perceptions [7], and metadiscourse and graphical design variants [3], all of which derive from the affordances of digital media.

Computer-mediated communication (hereafter CMC) has brought about a foregrounding of the scientist [8], emotional marketing and branding [9] and dissolution of boundaries between the private and public spheres, which has engendered a 'cyberspace college' [10] with a proximal communication code; that is, one based on the second-person and inclusive 'we' pronouns and deictics such as 'here' and 'now', which approach the sender, the scientific content and the communicative situation to the addressee. In this code, the traditionally sanitised academic discourse, which so many scholars have characterised as formal, depersonalised and factual [11–15], is acquiring a casual tone more fit for an informal conversation. Furthermore, the immediacy and resources offered by CMC have also raised the expectations of amusement in addressees and of promotion in institutions and corporations. The scientist's roles, in consequence, have come to include those of entertainer and advertiser, in addition to becoming a teacher and translator of technical concepts in the absence of science journalists. Moreover, as it is now required from scholars to transmit scientific content visually and multimodally, they are supposed to take on the role of graphic designers and filmmakers, unless they commission the task to professionals.

Despite these massive changes, Prior [16] (p. 520) notes that multimodality still remains a peripheral area of LSP (Language for Specific Purposes) research, as language has long determined topics and methods, and that the dominant questions posed by core journals in the field, such as *Journal of English for Academic Purposes* or *English for Specific Purposes Journal*, continue to be overwhelmingly language-focused. In this article, I set out to explore the challenges and problems caused by GAs and specifically by the phenomenon of visual stylisation, which may affect the implementation of more engaging dissemination models. In what follows, I shall describe the main features of the GA genre, provide a taxonomy of its visual stylisation and analyse its repercussions on the democratisation

of science. The focus on samples labelled as ‘ineffective’ by experts responds to the need to identify, with a view to their prevention, those graphical design practices that under expert eyes (specifically according to the criteria of science bloggers) obstruct the comprehension of scientific texts. A legitimate question that may arise is why not pay attention instead to those practices that ‘work’. The answer is that the supposedly ‘desirable’ or ‘effective’ graphical options proposed by multinational scientific publishers, such as Elsevier, displayed on its website until 2020 and which I have classified at the end of the results and discussion section and illustrated in Figures 6–9, have not ensured correct interpretations among experts [4]. Complex reception studies should be conducted in each discipline with representative expert populations in order to ascertain the degree to which a given graphical design strategy is ‘successful’ in a particular context.

One may also wonder about the social role of science bloggers, as they appear to be the only members of the scientific community who publicly criticise the efficacy of GA designs across disciplines. They perform the function of ‘whistle-blowers’ warning other experts against the effects of particular graphical choices and showing them how these may generate miscommunication at two different yet intertwined levels: in the interpretation of the scientific message and the greater or lesser trivialisation of the interaction. Although science bloggers may contribute to the popularisation of specialised content and, along with it, to the democratisation of science dissemination, it cannot be assured that this is a consciously undertaken mission.

My contention is that visual stylisation cannot achieve more engaging and effective dissemination without attending to intercultural issues and complying with unified journal guidelines for authors, many of whom would need instruction in visual literacy and design. In other words, since interpretive skills depend in large measure on the addressees’ cultural and scientific background and their acquaintance with the principles of visual representation, journal guidelines should inform of these principles, offer commented contrasts between desirable and ineffective practices, and thus stimulate reflexive creativity rather than achieving a unification of conventions through rigid graphical restrictions.

2. Methodology

The classification of stylisation types presented as outcome in this article results from the scrutiny of over 1000 GA samples from science blogs (slightly over 900 come from the archives of TOC-ROLF)² and research network forums, such as Academia.edu and ResearchGate, as well as from random findings in scientific journals (particularly from those specialised in the disciplines of Physical Chemistry and Chemical Physics) and GAs discovered by specialist teachers from my university (Universidad Politécnica de Madrid). To get an approximate idea of the current trends most criticised by science bloggers, I examined a total of 42 samples filed as arcane or trivial by the science blog TOC-ROLF between January and October 2021.

Although corpus representativeness is a construct, both theoretical [17] and methodological [18,19] and relies on intuition [20] since no ‘pure corpora’ can exist free from bias or theorisation, the samples in this study meet a threefold goal: first, they make the most recent GA corpus that could be compiled by the time this article was to be submitted. Second, they cover nearly a whole year of publication—the ten-month span from January to October 2021. Third, the 42 instances within that period suffice to give an idea of the various types of GAs criticised as ineffective in science blogs, and fourth, they come from several journals and disciplines. The predominance of GAs from Chemical Physics and Physical Chemistry over other fields is to be taken as naturally occurring data. Yet, it should be borne in mind that the elementary nature of their phenomena might pose less of a challenge for creative visual representation and metaphorical rendition than those from other disciplines, which may account for their abundance.

Multimodal analyses have been based on the principles and categorisations devised by Kress and van Leeuwen [21] and Machin [22], two of the most exhaustive categorisations within the panorama of Multimodality. The 42 samples possess graphical singularities that

belong to those categorisations and may justify their 'inefficacious' status, according to science bloggers. These multimodal parameters are strongly culture-bound, and their power of connotation is worthy of notice. The major classifying parameters are the following:

- (1) Semiotics of colour
 - a. Colour modulation (flat vs. nuanced);
 - b. Tone;
 - c. Hue;
 - d. Saturation vs. dilution;
 - e. Brightness;
 - f. Luminosity;
 - g. Differentiation (from monochrome to polychrome);
 - h. Purity vs. Hybridity.
- (2) Typography
 - a. Weight (bolds vs. slimmer typefaces);
 - b. Expansion (condensed or spread out characters);
 - c. Slope;
 - d. Curvature;
 - e. Connectivity;
 - f. Orientation;
 - g. Spacing and alignment;
 - h. Flourishes.
- (3) Composition and panel layout
 - a. Salience
 - i. Cultural symbology;
 - ii. Colour;
 - iii. Tone;
 - iv. Focus;
 - v. Foregrounding;
 - vi. Overlapping.
 - b. Informative value through spatial placement
 - i. Top/bottom positioning;
 - ii. Triptych and centre/margin compositions;
 - iii. Embedded structures.
 - c. Framing
 - i. Segregation;
 - ii. Separation;
 - iii. Integration;
 - iv. Overlapping;
 - v. Rhyming;
 - vi. Contrast.
- (4) Iconography
 - a. Poses;
 - b. Types of objects;
 - c. Settings;
 - d. Iconographic symbolism.
- (5) Modality markers
 - a. Degree in the articulation of detail
 - i. Naturalistic vs. abstract;
 - ii. Real-size or blown up;
 - b. Degree in the articulation of backgrounds;

- c. Interplay of light and shadow;
 - d. Visual depth.
- (6) Representation of social actors
- a. Kinds of participants;
 - i. Individuals vs. groups;
 - ii. Anonymous;
 - iii. Archetypes.
 - b. Agency and action (roles)
 - i. Material;
 - ii. Behavioural;
 - iii. Verbal;
 - iv. Relational;
 - v. Existential;
 - vi. Mental.
 - c. Distance
 - d. Angle of interaction
 - i. Horizontal;
 - ii. Vertical;
 - iii. Oblique.
 - e. Gaze
 - i. Direct vs. indirect.

Metadiscursive parallelisms between the verbal and the visual have been drawn from Hyland's [23] taxonomy of interactive and interactional metadiscourse, which expands the notion beyond the mere textual scope into the interpersonal sphere. Colour, typography, composition and iconography may fulfill metadiscursive functions on either sphere and thus can transmit scientific content, while at the same time conveying emotion or connoting experience. On the interactive plane, it is interesting to discover what graphical devices are used as frame markers (in particular, as sequencers, stage labelers, topic shifters and transition markers or inferentials) to signpost the scientific narrative and discuss their efficacy. On the interactional plane, it is convenient to check if authors leave any personal imprint equivalent to a self-mention and whether the emphasizing (i.e., boosting) or mitigating (i.e., hedging) and attitudinal functions of colour, size, spatial collocation, typography, iconography (e.g., emojis) and expressive punctuation are intelligible and serve to enhance the message, and what engagement resources are exploited to engage readers/viewers. For example, question marks, lines, arrows, colour gradation and spatial collocation as directives; tropes, humour and cultural symbols as markers of shared knowledge or experience; and background or faded elements as potential asides or incidental disclosures.

Likewise, the concept of 'metaphorical scenario' has been borrowed from Musolff [24] to embrace metaphorical embodiments beyond the strictly notional into situational frames and behavioural patterns. Although the idea arose within the study of political discourse, its application is useful in other areas of human activity and natural phenomena. Visual tropes (mostly metaphors and metonymies) may reinforce cultural and disciplinary bonds through common cognitive schemata as markers of shared knowledge, perception and experience and regularly go hand in hand with humour. It is then necessary to see whether this association trivialises the scientific dissemination or helps to understand its content and grab and sustain the interest of viewers.

3. Findings and Their Discussion

3.1. First-Approach Perceptions: Major Challenges of the Graphical Abstract as Hybrid Genre

Regardless of their semiotic mode, host genre and format, abstracts have been defined as screening devices and previews of the research article [25], as selective representations rather than accurate summaries [26], and as promotional devices [26], even being metapho-

rised as the ‘shop windows of science’ [27] (p. 2). Visual abstracts could be labelled as ‘hybrid’ (see Bhatia [28,29]) or ‘enculturated’ research genres due to their intersemiosis and interdiscursivity. They merge creation and mimesis, the verbal and the visual, naturalistic and symbolic representations, and borrow elements from a variety of discourses, such as marketing and advertising, fiction literature, the graphic novel and the comic book, cartooning, photography and film. They are also multifunctional because they simultaneously encapsulate, engage, promote and serve as complex metadiscourse items. In this last respect, they may act as goal announcers providing the ‘roadmap’ of the article, as code glosses by means of embedded metaphorical narratives and analogies, as cognitive directives guiding the addressees’ interpretation, as stage-labellers (if they consist in a single frozen image), and as attitudinal markers (depending on the type of rendition and artwork).

It is uncertain whether this enculturation or hybridity will result in acculturation, that is, in the total loss of idiosyncratic values and features due to the adoption of the dominant culture, in this case, that of marketing and advertising, or in a definitely failed democratisation of science dissemination. What seems clear is that, in visual abstracts, the deferential writer-responsible values of academic writing are giving way to a reader-responsible culture in which it is up to the readers/viewers to expose themselves to the stimulus or target information and focus their attention to finally recognise the message. This is the principle of the advertising–marketing culture [30–32], in which overt metadiscursive engagement markers (e.g., rhetorical questions, reader pronouns and mentions, asides, directives and expressions of shared knowledge in Hyland’s 2005 taxonomy [23]) are not resorted to as much as in academia. Perhaps this displacement of responsibilities and orientations (from writer-responsible or reader-oriented to reader-responsible or writer-oriented) is the most remarkable discursive practice introduced by visual abstracts, which entail a threefold challenge (Figure 1): *transduction* [33], termed ‘semiotic remediation’ by Prior [16], *regenring* [34], called ‘re-purposing’ by Prior [16], and *discourse economy*.

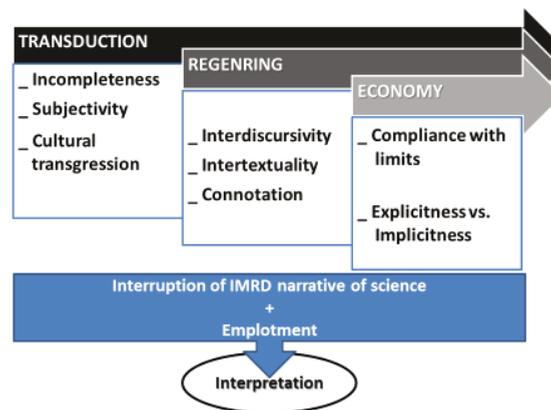


Figure 1. Threefold challenge due to visuality in GAs and video abstracts.

Transduction is the resemiotisation of content into a different mode of meaning: in the case of GAs, the conventional verbal summary of scientific articles, on average ranging from 100 to 300 words, is converted into an image or series of images fitting into a single panel. Regenring is a genre shift that modifies (either by clipping, by elaboration, or by some other type of manipulation) and reorganises that content in a way and with a purpose that substantially differ from the original aim, arrangement and/or extension. Discourse economy imposes extension limits, be they as a maximum footage duration for video abstracts, restricted space (frequently one panel) for GAs, number of points or aspects dealt with (so as not to clutter the space available for GAs and prevent cognitive overload in

video abstract viewers), file size, colour palette and saturation, and inclusion or exclusion of verbal text. All these limits and restrictions depend very much on journal policy.

The challenges inherent in transduction are *incompleteness*, *subjectivity* and *cultural transgression*. Static visuals are holistic and cannot express verbal content fully, so the information conveyed in a GA must necessarily be incomplete. Incompleteness normally impinges upon the representation of stages in the research process, as GAs showing a complete IMRD narrative sequence (i.e., Introduction–Method–Results–Discussion/Conclusion) do not abound. The addressee must then work out what moves are shown, which tend to be the methods and results stages in a sort of ‘before’ and ‘after’ narrative sequence. Yet the perception of qualitative evolution or of changes of state or condition is not always immediate because it may depend on minimal visual detail that requires full attention and not be guided by vectors (arrows or lines indicating the reading path) but by contiguous collocation. In such cases, as in sample (1), the cognitive processing effort is high and resembles the pastime activity of ‘spot the differences’ between two diagrams depicting two consecutive phases in the process of cellular resistance to anticancer agent doxorubicin. For the non-expert viewer or for experts with an untrained eye, such cognitive investment goes against the immediacy and efficacy expected from good summaries.

(1) <http://dx.doi.org/10.1016/j.bcp.2009.09.004> (accessed on 4 November 2021)

(2) <https://doi.org/10.1016/j.engstruct.2012.01.014> (accessed on 4 November 2021)

It may happen that the vectorless stage sequence consists of two disparate representations, as in sample (2), which contrasts a drawing sketch and a photograph of the same object of study (a beam joint) during a testing procedure. The legends explaining each image are not very telling, and neither are the ‘frozen moments’ captured in the visuals. These two samples are prototypical instances of compositional stylisation or layout subjectivity, which shall be further explored in a following section.

The selection of genre moves and steps, topical aspects and composition layouts is subjective and may go against the representational tradition of a given culture or even incur social taboo. A good case in point is Sample (3), which represents the properties of certain chemical elements as human behaviour. The resonance effects and affinity or bonding potential between zinc and selenium are metaphorised as a two-panel disco dance scene involving human silhouettes, where a female character in a mini-skirt (marked as zinc) dances provocatively to attract a male figure embodying selenium. This type of rendition may be not only misunderstood by certain cultures but also come across as offensive to particular religious creeds and gender collectivities with different mindsets and derived social roles, since the female character in (3) might appear as much too disinhibited or even lewd for some.

(3) <https://doi.org/10.1039/C5CP04498G> (accessed on 4 November 2021)

In a similar vein, regenerating may—intentionally or not—involve discursal and textual loans and connote other interactions from distant spheres of human activity (e.g., journalism, art, fiction, advertising, comics, movies, etc.), but their perception is obviously conditioned by the addressee’s cultural background and interpretive skills, particularly by metaphorical thought. Sample (4) is an instance of interdiscursivity with a discourse borrowed from outside science, concretely from Marketing and Advertising. The image in question verges on regenerating because of its resemblance with a billboard or press advertisement, especially in its close-up take of the object/product to be promoted or paid attention to, and the involvement of the audience through a rhetorical question without any contextualisation and a direct appeal through the second person pronoun (‘you’). In addition, the proximal tone achieved is characteristic with an ‘exclusive we’ pronoun as a marker of both nearness and authority.

(4) <https://pubs.rsc.org/en/content/articlelanding/2013/cc/c3cc44118k> (accessed on 4 November 2021)

More conspicuously perceived than interdiscursivity, intertextuality aims at establishing ‘universal analogies’ by using visual and/or verbal references to widespread texts from literature, film, videogames, sports and other fields of human activity, as well as cultural icons and symbols and other presumably widespread life experiences. The choice of ‘universal’ references is per se subjective, despite the global reach of digital networks and other mass media: Can it be ensured that, say, an Asian or African scientist is fully familiarised with well-known works of art and literary and filmic canons from the western culture? And why should the western culture be the only referential basis for every connotation, analogy, metaphor and comparison used to disseminate and promote scientific achievements? Is it due to a population size criterion or to a matter of power?

It cannot be denied that, by and large, science and technology are practically in the hands of a few highly industrialised countries with a Judeo-Christian origin, but that should not oblige experts with other backgrounds to acquire the cultural level necessary to decode scientific content in a genre whose major purpose is screening and encapsulating, not entertaining. However, messages praising the aesthetic and amusing qualities of visual abstracts, such as that launched in 2018 by biologist and journalist Kerry Evans (Senior Managing Editor for *AJHG* and *Immunity* and in charge of the Cell Press blog ‘Crosstalk’), have fuelled the idea that entertaining is part of their objective. She holds that there is no reason why Cell’s video abstracts cannot be enjoyed by lay readers/viewers:

“Just because Cell video abstracts are primarily intended for scientists doesn’t mean your kindergartener or grandparent can’t enjoy this.” [35]

To the discourse analyst, nonetheless, entertainment without content comprehension is difficult to imagine, and chances that scholars gloss their scientific texts for laypeople are really thin unless the intention is to produce an outreach version. The publishers’ view of scientific communication between experts as an amusing interaction seems then to clash with that of scholars, for whom it is a concise, informative transaction with a high degree of taken-for-granted knowledge.

While the verbal abstract is infallibly literal, monosemic and discourse-specific, its graphical and video variants are allowed to be metaphorical and interdiscursive, even polysemic for the ideal audience, depending on the degree of literalness adopted. This fact might lead us to think that the intended addressees of verbal and graphical abstracts could be different, although no scholar has as yet disclosed an intention to reach out to laypeople by means of GAs. Sample (5) expresses scientific doubt with the Shakespearian plot of *The Tragedy of Hamlet, Prince of Denmark*. As shown in (5), the ‘ad hoc pointer’ [36] or ‘metaphorical trigger’ that signals the metaphorical nature of the encoding is the molecule held by the character dressed in a 16th-century attire, who should instead hold a skull, according to the Shakespearian play. The verbal and phonic pun of the title “tBu or not tBu?” (a question which emulates Hamlet’s famous soliloquy “To be or not to be, that is the question”) is another pointer, tBu being the name of the ligand molecule studied. In the verbal paraphrase of the GA facilitated by the journal (very few publishers do), the authors describe their article as ‘a Hamlet study’, a qualification that contrasts starkly with the technical register used in the remainder of the paraphrasing paragraph.

(5) <https://doi.org/10.1002/chem.201102674> (accessed on 4 November 2021)

Intertextual choices likely to be less ‘universal’ are (6), an allusion to the sentence “Quo vadis?” from the Acts of Peter, one of the earliest apocryphal Acts of the Apostles in Christianity and later on inspiration for Henrik Sienkiewicz’s 1896 novel *Quo Vadis*, and the national folklore instances showcased by (7) and (8), which respectively embody Aesop’s fable *The Hare and the Tortoise* and the popular idiom ‘carrot-and-stick’, used to denote a dual motivational approach consisting in reward and punishment. In both samples, the authors have spared any verbal clue, which indicates that they regard their cultural referents as accessible enough.

(6) https://doi.org/10.1007/10_2018_75 (accessed on 4 November 2021)

(7) <https://doi.org/10.1039/C5PY01964H> (accessed on 4 November 2021)

A yet more subtle level of decodification based on evoked concepts or situations/scenes is connotation. Sample (8) parodies the TV programme *The Joy of Painting*, broadcast between 1983 and 1994 in the USA by PBS. In it, artist Bob Ross (1942–1995), soon a celebrity, painted canvases live in less than 30 min to explain diverse rapid pictorial techniques. The palette held by his caricature in this GA contains only cobalt blue dollops, and his paintbrush represents the zinc element, with which the brushstrokes on the canvas seem to be applied with extreme smoothness. The artist's characteristic permed hairstyle is here hexagonally shaped, iconic of the catalyst molecule under research. The processing of the information conveyed in this GA is not easy for scientists unexposed to the said TV programme, whose metaphorical scenario is not directly related with the research topic, but laterally suggested by the shared features of rapidity and simplicity: the cobalt–zinc catalyst is as quick and smooth as Ross' painting. How many researchers from outside the USA are able to recognise the caricature and then deduce this implicit association? Undoubtedly, Bob Ross has had an impact beyond the U.S. frontiers because, curiously enough, the GA authors are four German scholars based in Munich and a Chinese national affiliated to Wuhan University, but surely Ross' popularity will vary across countries and his figure may be unknown in some of them around the globe. It remains uncertain how the five authors became acquainted with the celebrity and whether they took for granted a 'universal' audience for their GA. Can this case be considered an instance of cultural colonisation or imposition within the scientific community?

(8) <https://doi.org/10.1002/cctc.201901939> (accessed on 4 November 2021)

To conclude, the compliance with extension limits and the primary goal of summarising content brings along a discursive economy in the form of omission (of information taken for granted or considered superfluous) or implicitness (information subtly hinted at in a visual manner). Variations on the hare-and-tortoise motif containing only one of the two characters in the story, most often the victorious turtle (see Sample 9), exemplify the strategy of omission and assume that addressees know the plot, which makes it unnecessary to include the defeated hare. Sample (10) is another mixture of omission and implicitness: the addressee's knowledge of the chemical arrangement of the nanoparticles under study theoretically suffices for a successful interpretation of the image, although it may not be so in practice.

(9) <https://doi.org/10.1002/chem.201103973> (accessed on 4 November 2021)

(10) <https://pubs.acs.org/doi/abs/10.1021/jp407495z> (accessed on 4 November 2021)

So far we have seen how the three main challenges generated by visuality in science dissemination (i.e., transduction, regenerating and discursive economy) frequently cause the interruption of the IMRD narrative sequence of GAs or intervene in it and lend themselves to embedded emplotments devised to epitomise, clarify through metaphorical analogies and seek memorability of the scientific content, all of which affect interpretation. We have also had the opportunity to observe that in many instances there is a stylised or subjective presentation of the visual message. Let us now turn to the definition of the stylisation phenomenon and its repercussions upon science dissemination.

3.2. *Finer-Grained Results: A Working Definition of Stylisation, Taxonomy and Outstanding Issues*

Stylisation is not all about embellishment, although part of it may be aesthetically motivated. I define the concept as a subjective encoding of information, in this case scientific, out of pragmatic and aesthetic reasons, which frequently leaves an authorial imprint and affects the comprehension of the message. Stylisation has to do with individuals' creativity and subjectivity, since it does not strictly follow external guidelines and norms, may traverse all the three major challenges posed by visuality (i.e., transduction, regenerating and discourse economy—see again Figure 1), and even operate metaphorically by recounting scientific and technical facts with embedded non-scientific narratives. In these, recourse to intertextuality, interdiscursivity metaphorical scenarios and connotation (the latter in

more subtle encodings) is common. Some instances have already been shown in samples (3)–(10).

Hence, stylisation may deal with notional, interactional and compositional aspects alike (i.e., roughly corresponding with the functions of language put forth by Systemic Functional Linguistics: ideational, interactional and textual) and exhibit varying degrees of complexity that range from mere ornamentation to multiple metaphorical embodiments, sometimes nested. Figure 2 shows a taxonomy proposal that divides stylisation into ‘simple’ (essentially consisting in embellishment) and ‘complex’ (conceptualising facts or phenomena).

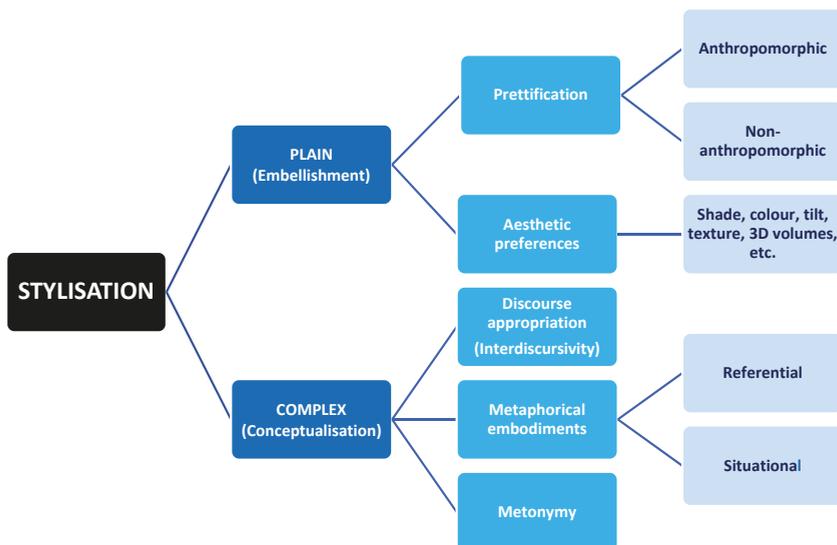


Figure 2. A proposed taxonomy of stylisation in GAs.

Within plain stylisation (i.e., embellishment), ‘prettification’ is the term used by science bloggers to denote the subjective representation of chemical elements and compounds, atoms and molecules, microorganisms, animals, plants and processes as animate beings, among which anthropomorphic shapes and facial expressions are rife. Samples (11) and (12) are instances of anthropomorphical prettification. While the one in (11) does not seem to affect the interpretation of the scientific information, that of (12) might contribute to a more accurate comprehension since the prettified molecule has additionally been metaphorised into a human archer aiming his/her arrow at a chemical (O_2) target, which suggests agency and accuracy on the part of the substance prettified. A case of non-anthropomorphic prettification is (13), where the sweetener molecule synthesised is metonymically rendered as ice cream on a wafer cone.

(11) <https://doi.org/10.1021/co500146u> (accessed on 4 November 2021)

(12) <https://doi.org/10.1039/C3CC47261B> (accessed on 4 November 2021)

(13) <https://pubs.acs.org/doi/abs/10.1021/jf301600m?mi=14f7i14&af=R> (Accessed 30 November 2021)

It is not common to find visual metonymy in isolation. Very occasionally, it is used to represent actions that integrate the methods stage in the research and epitomises those actions with the instruments or tools with which they are performed: for example, a syringe for inoculation, a stove for drying, a tap for water rinsing, or a clock for waiting time. Metonymic ‘purity’, anyhow, is a debatable concept, as all the former instances

could be conceived as metaphors under the conceptual schema AN ACTION IS ITS INSTRUMENT/TOOL.

Prettification, oftentimes aided by cartooning and comic book techniques, brings about register shifts that trivialise the communication or turn it into an informal interaction. In (14), two molecules have human-like bodies and, although faceless, speak and their utterances appear contained in speech bubbles, whereas in (15), a thought balloon is attributed to an insect. Certainly, these kinds of stylisations do not hamper the democratisation of science: they do not segregate readers/viewers nor hinder the grasp of scientific content but contribute to ingraining the goal of entertainment in science dissemination, which might end up threatening interpretation if pursued at all costs.

(14) <https://pubs.acs.org/doi/10.1021/jp4081977> (accessed on 4 November 2021)

(15) <https://www.mdpi.com/2072-6643/5/5/1622> (accessed on 4 November 2021)

Aesthetic preferences involving colour, shading, image orientation, texture, or three-dimensional effects are potentially less innocuous than prettification, as Sample (16) demonstrates. The arbitrary shading of its molecule segments may lead to a mistaken interpretation of the shaded areas as bonding surfaces, an ambiguity criticised by science bloggers.

(16) <https://onlinelibrary.wiley.com/doi/abs/10.1002/anie.200904588> (accessed on 4 November 2021)

All in all, then, the chief dangers of stylisation, be it strictly graphical or conceptual, are trivialisation, exclusion and misinterpretation—the latter two repercussions even among experts. Displayed in Figure 3 are the resources causing the GAs selected from the TOC-ROLF science blog to be deemed ineffective in their summarising, screening and disseminating function.

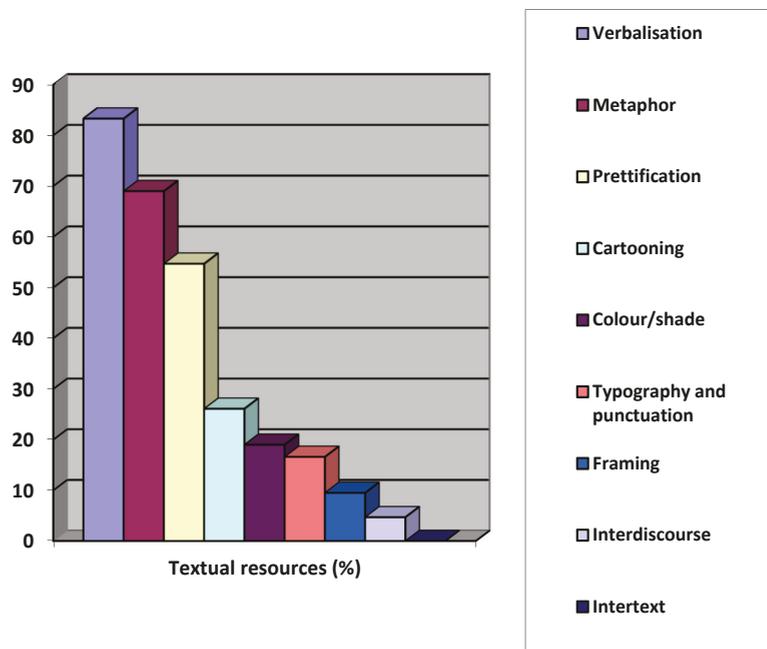


Figure 3. Percentages of the textual resources used in the TOC-ROLF blog's 2021 samples (January–October).

Noticeably, there is a predominant use of verbal insertions (83.3%), mostly of succinct noun phrase labels (73.8%). By contrast, verbalisations comprising one or more sentences are relatively scarce (9.5%) and associated with speech bubbles and thought balloons,

two cartooning techniques that inevitably shift the academic register into an informal interaction. Other techniques present are creative panelling, spiky balloons to denote loud sound, clash or violent reaction, explanatory captions and movement runes. Slightly over half of the samples (54.7%) prettify human characters, animals, objects, molecules and chemical elements or substances, and somewhat less than 20% make use of shading and colour saturation, which also alters the register. Only two instances appropriate the visual discourse of Advertising: one with a close-up photograph of a glass of beer with the printed question “How many bubbles?” as the hook, which clips the engaging title of the article “How many CO₂ bubbles in a glass of beer?” (17):

(17) <https://doi.org/10.1021/acsomega.1c00256> (accessed on 4 November 2021)

and the other (18) with a full-blown mimic of a cow that intriguingly resembles that of the ‘La vache qui rit’ brand icon³, of the Groupe Bel food firm:

(18) <https://doi.org/10.1021/acs.inorgchem.9b03563> (accessed on 4 November 2021)

Finally, also worthy of attention are the facts that recourse to intertextuality is non-existent and that metaphor is the second most used device (a little below 70%), but with a prevalence of object- or concept-based mappings (45.2%) over scenario-based ones (23.8%) in the source domain. None of the science metaphors detected evokes works of art, literature or film but prosaic life experiences applied to the target entities or processes to be described, or extremely unrealistic situations created ad hoc. Some examples of each variant are presented in Table 1, which rates their proximity or familiarity to the addressee (‘commonplace’ versus ‘unrealistic’ objects and experiences). Regardless of these two degrees of proximity, however, there is always a ‘metaphorical trigger’ or ‘ad hoc pointer’ [36], an incongruous element that beacons the need for not interpreting the embodiment literally. Prettification itself, some bizarre visual associations (e.g., a string coming out of a molecule for a cat to play with, perhaps representing bonding lengths), the insertion of scientific matter (e.g., chemical formulas and mathematical calculations, molecular models and microscopic images), verbal labels, or even colour saturation and whimsical framings are but a few of the devices serving as triggers.

In the context of science and technology dissemination, necessarily monosemic, economic and linear in the rhetorical organisation of its specialised discourse, many interpretive difficulties at a structural level reside in the motivation of the metaphorical embodiments of abridged visual texts, such as GAs and video-abstracts. It is relatively easy, therefore, to identify metaphorical triggers and the elements that are ‘out of place’, but sometimes it is rather complicated to find out the relationship between the source and target entities, no matter the amount of technical expertise. Occasionally, the covert motivation is subtly metonymic, as in the GA (mentioned in Table 1) showing a prettified Santa Claus-like molecule of holmium oxyhydride at a sunny beach to suggest thermal stability. The relationship has to do with the stoichiometric composition (HoHo) of the substance, reminiscent of Santa’s typical laughter (19):

(19) <https://doi.org/10.1021/acs.inorgchem.0c03822> (accessed on 4 November 2021)

In another of the samples (20), also referred to in the table, an octopus-like chemical compound with a hat on to protect its ionic head, is sitting on a gold ingot, in front of several switches. The whole scene refers to the compound’s multiple ligand properties, equated with eight tentacles, particularly with gold and with a view to developing nanoscale molecular switching materials:

(20) <https://tocrofl.tumblr.com/post/666579375759753216/octopus-in-hat-switching-switches> (accessed on 4 November 2021)

Table 1. Some salient examples of object-based and scenario-based metaphorical embodiments in the blog samples studied (TOC-ROLF January–October 2021).

Trigger	Object	Proximity	Scenario	Trigger
Chemical formulae above and beside exclamation mark	Multilayered sandwich (Suggesting compactness and internal structural features)		Fishing	Fish-shaped molecules
Chemical formula on it	Glazed doughnut (Relevance unknown without reading full article)	COMMONPLACE	Cat playing with string	String attached to solid molecular model, animal prettification
Prettified molecule inside	Cage (Embodying ionic sequestration)		Job hunting	Prettified molecule in suit and with briefcase, holding its CV
Source-domain mappings in object-based metaphorical schemata		UNREALISTIC	Santa Claus at the beach	Prettified molecule, colour saturation
			Meal guests along an industrial conveyor belt	Prettified molecules, weird etiquette
			Octopus with hat on and seated on gold ingot in front of switches	Prettification, formulas and graph around

This small-scale analysis brings to light the complex metadiscursive multifunctionality of GAs: at a macrolevel and according to Hyland’s categorization [23], they work as engagement markers (i.e., as attention-getters and cognitive directives guiding the addressees’ interpretation) and as glosses (via some vectors, didactic metaphors and embedded narratives parallel to or interrupting the rhetorical IMRD pattern of science dissemination). They also function as evidentials, if they consist of visuals displaying results from the original study and serve as goal announcers when inserted in the research article between the authors’ names and affiliations and the introduction. At a microlevel, they may contain a wide array of visual metadiscourse items in tension between mimesis and expression, a rooted feature of science iconography [37]. Many such items coincide with the elements enumerated by Kress and van Leeuwen’s attempt [21] at building a visual grammar and with Machin’s prompts for multimodal analysis [22], both of which comprise vectors (arrows, lines, runes, etc.), frames, collocation, sizes, light and chromatic effects, typography, perspective and angles of interaction, and degrees in the articulation of detail. This coincidence of resources, most probably, will be the result of intuitive choices on the scholars’ end, who very seldom receive any institutional training in visual design.

In light of all the former, it is reasonable to expect that repertoires vary across disciplines and in the end position scholars and research areas with regard to the scientific message and its intended audience. A skimming look through the TOC-ROLF archive since its earliest entries in August 2010 reveals that some motifs are ‘endemic’ to certain scientific fields, such as the use of Aesop’s hare and tortoise fable to qualify the efficacy of catalysers and chemical reactions in Physical Chemistry and Chemical Physics. Storylines of this kind (provided by metaphorical scenarios from literature, film and folklore) constitute, together with speech acts (especially interrogative and commissive ones, in the form of rhetorical questions and verbal or visual commands) and past and imposed positions, the three pillars of any positioning action, which are known as ‘positioning cluster/triangle’ [38]. By ‘past positions’ we should understand the scientists’ dissemination trajectory in publishing

and public speaking, with all the visual resources they have employed thus far out of personal preference in GAs, in-article illustrations, and slides for lectures and conference presentations. By ‘imposed positions’ we should interpret the vetoes, restrictions and encouraged options (e.g., exemplars, templates, imitation trends in scholarly circles and author guidelines in general) fostered by the discipline or field and by scientific journals and conference committees.

Logically, the recording of individual positioning turns very difficult, because it implies tracking the ‘visual biography’ of each researcher diachronically along his/her academic career and across different genres, whereas the synchronic description of disciplinary and editorial positions, of collective ‘visual identities’, is more feasible. On the other hand, and as happens with verbal metadiscourse items in Hyland’s taxonomy [23], certain visual resources may be overlappingly perceived as members of different categories. Arrow-shaped vectors, for instance, may be decoded as interactive and interactional at the same time; that is to say, as sequencers and cognitive directives (engaging commissive markers), whereas the expression of dissuasion, disapproval or rejection of actions not to be performed in a particular scientific procedure are more explicitly and unambiguously marked by sad or angry emoji gestures, red crosses and prohibition signs. Just like verbal metadiscourse, in sum, one item may fulfil several functions and one function may be performed by several forms, which in GAs jeopardises interpretation even more than in the verbal encodings of conventional abstracts, given that visuals are by nature holistic and schematic and GAs offer very little room for verbal inserts and proper contextualisations.

The disciplinary provenance of the TOC-ROLF samples analysed is quite homogeneous. Out of the 22 journals represented in the ten-month corpus, the majority was found to address the global chemistry community or to belong to broad subdisciplines, such as Inorganic and Organic Chemistry (Figure 4). The established combined disciplines of Chemical Physics and Physical Chemistry (9% of corpus instances) and multidisciplinary journals (14%) covering a wide-ranging spectrum of (sub)disciplines at the interface of Materials Science, Chemistry, Engineering, Physics, Medicine and Biology yield not very disparate smaller proportions, as can be seen in the pie chart of Figure 4. The titles of the journals in question are listed and sorted out by discipline in Table 2, which shows an overwhelming presence of the ACS Publishing Center, followed in equal proportion by Elsevier and Wiley, and at a small distance by the Royal Society of Chemistry, based in the U.K. Springer Publishing, in contrast, trails behind with only one sample. A focus on the percentual weight of each publisher’s presence in the corpus is shown in Figure 5.

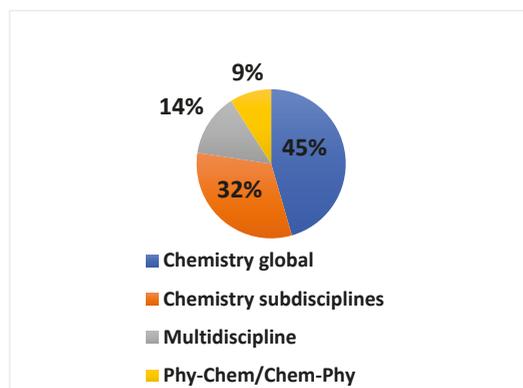
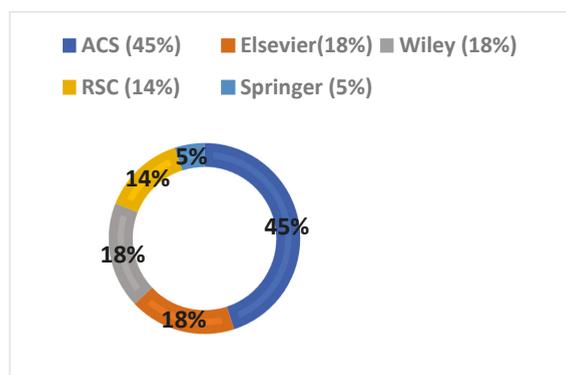


Figure 4. Percentages of samples’ disciplinary provenance.

Table 2. Journal titles and publishers classified by discipline.

Discipline	Title	Publisher
GLOBAL CHEMISTRY	<i>Accounts of Chemical Research</i>	ACS
	<i>ACS Omega</i>	ACS
	<i>Chemical Reviews</i>	ACS
	<i>Chemical Science</i>	RSC
	<i>Chemistry. A European Journal</i>	Wiley
	<i>Journal of the American Chemical Society</i>	ACS
	<i>Journal of Chemical Theory and Computation</i>	ACS
	<i>Monatshefte für Chemie-Chemical Monthly</i>	Springer
	<i>Small: Nano-Micro</i>	Wiley
	<i>RSC Advances</i>	RSC
SUBDISCIPLINES	<i>ChemCatChem—The European Society Journal for Catalysis</i>	Wiley
	<i>EurJOC—European Journal of Organic Chemistry</i>	Wiley
	<i>Green Chemistry</i>	RSC
	<i>Inorganic Chemistry</i>	ACS
	<i>Journal of Organic Chemistry</i>	ACS
	<i>Journal of Organometallic Chemistry</i>	Elsevier
CHEMICAL PHYSICS and PHYSICAL CHEMISTRY	<i>Tetrahedron</i>	Elsevier
	<i>The Journal of Physical Chemistry</i>	ACS
MULTIDISCIPLINARY	<i>The Journal of Physical Chemistry Letters</i>	ACS
	<i>ACS Macroletters</i>	ACS
	<i>Environmental Pollution</i>	Elsevier
	<i>Journal of Functional Foods</i>	Elsevier

**Figure 5.** Percentages of publishers' presence in the corpus.

Although the larger presence of a particular publisher (see Table 2 and Figure 5) might suggest vaguer instructions to authors, it is not necessarily so, as other factors may come into play, such as journal impact, reviewing times, percentages of rejection, or topic currency and centrality. Springer's *Monatshefte für Chemie-Chemical Monthly*, for example, is represented by one single sample and does not issue specific guidelines for GAs, just

a 'template for chemical drawings' tackling aspects such as 'line art', 'colour art', 'figure captions', 'figure lettering and numbering', or 'figure placement and size'.

The rest of publishers' policies are more concrete and referred to GAs, also called 'ToC image', 'ToC graphic/figure', 'ToC entry', or 'graphical ToC' (ToC being the abbreviation for 'table of contents'), yet specificity may increase in the guidelines for authors of each of their journals. ACS Publishing Center, nevertheless, just issues a set of general instructions accessible through a link in each of its journals and remarks that the graphic should be simple, informative and understood by someone who has not read the manuscript. It may consist in a structure, a graph, drawing, photo, scheme or a combination, and should avoid long phrases or sentences, as well as the inclusion of photographs and caricatures of any person, living or deceased. The use of colour is encouraged (an instruction shared by all publishers), and the standards of scholarly professional publications must be met, although they are not spelled out.

In its general guidelines, RSC includes a series of 'do's' and 'don'ts' that limit verbal text to 15–25 words and graphical elements to a maximum of two, recommending focusing only on key findings and using easily recognisable words that can be read quickly. Among the don'ts are the repetition of information present in the title and the use of graphs, spectra and too much detail. Its journal *RSC Advances* adds the specifications that the visual must comply with the principles of political correctness and not contain logos, trademarks or brand names, the text supplied must be one or two sentences long and comprise a maximum of 250 characters, and the graphic should 'capture the reader's attention' (without any provision of compositional resources).

Wiley is the only publishing company that presents potential authors with the initiative of commissioning the GA to a professional in-house designer, and provides three exemplars respectively structured into one, two and three panels to show possible outcomes. Its general guidelines for authors detail the graphic's dimensions, the type of file, copyright issues, and vaguely encourages selecting a figure that 'best represents the scope of the paper'. More restrictive instructions are those issued by its journals: when dealing with political correctness, *ChemCatChem* and *EurJOC* allow recourse to elements of mythology, legends and folklore, which might be accepted on a case-by-case basis, but their policies discourage the use of religious iconography and imagery and of any object with a cultural significance. *Chemistry. A European Journal* discards, in addition, needless shading and asks authors to check the journal's policy of colour use. The fourth of the Wiley journals, *Small*, demands that the accompanying verbal text does not exceed 60 words, is written in the third person and for a 'general audience', a rather fuzzy requisite within such a stringent condition.

The four Elsevier samples in the corpus will surely have followed the guidelines for GAs in the publisher's website until 2020. According to them, the visual should allow readers to 'quickly gain an understanding of the main take-home message of the paper', 'encourage browsing' and 'promote interdisciplinary scholarship'. It is assumed to represent 'the work described in the paper' and adopt any of the compositional patterns found among the 16 exemplars shown online during the time span 2015–2020, whose basic typology is summarised in Figures 6–9.

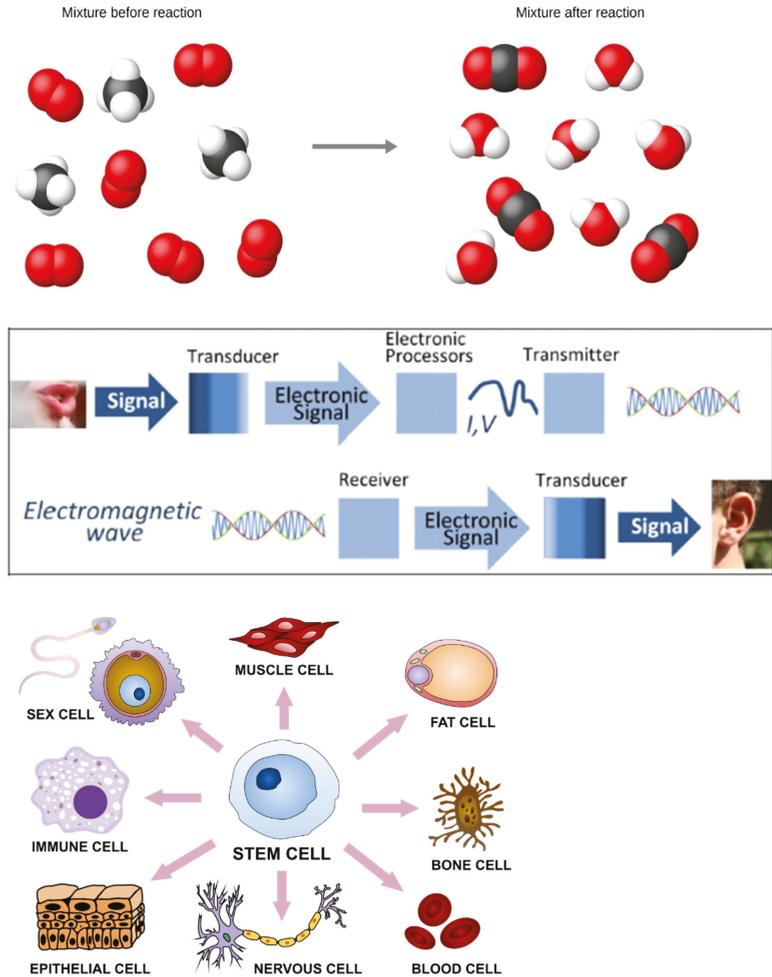


Figure 6. Arrows as narrative (top), reading path (centre) and classificatory (bottom) devices [39–41].

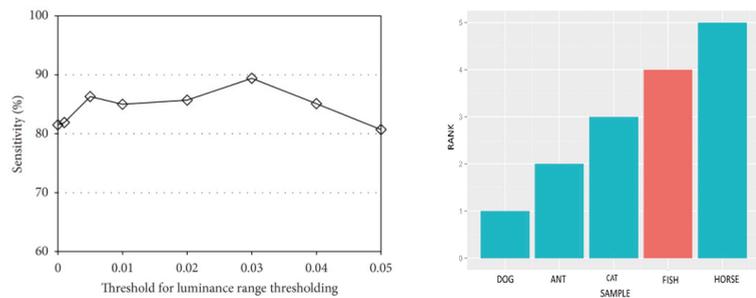


Figure 7. Some instances of ‘data displays’ [42,43].

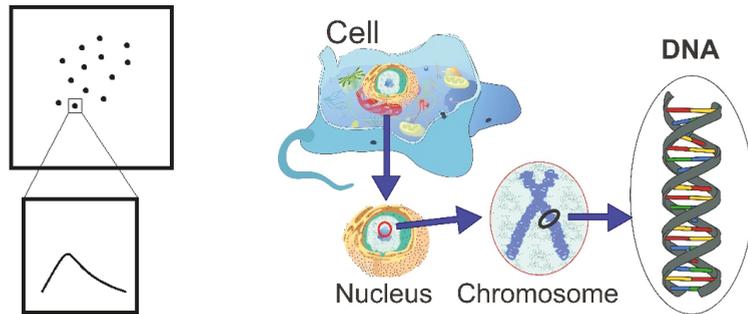


Figure 8. Zoom-ins for detail foregrounding [44,45].

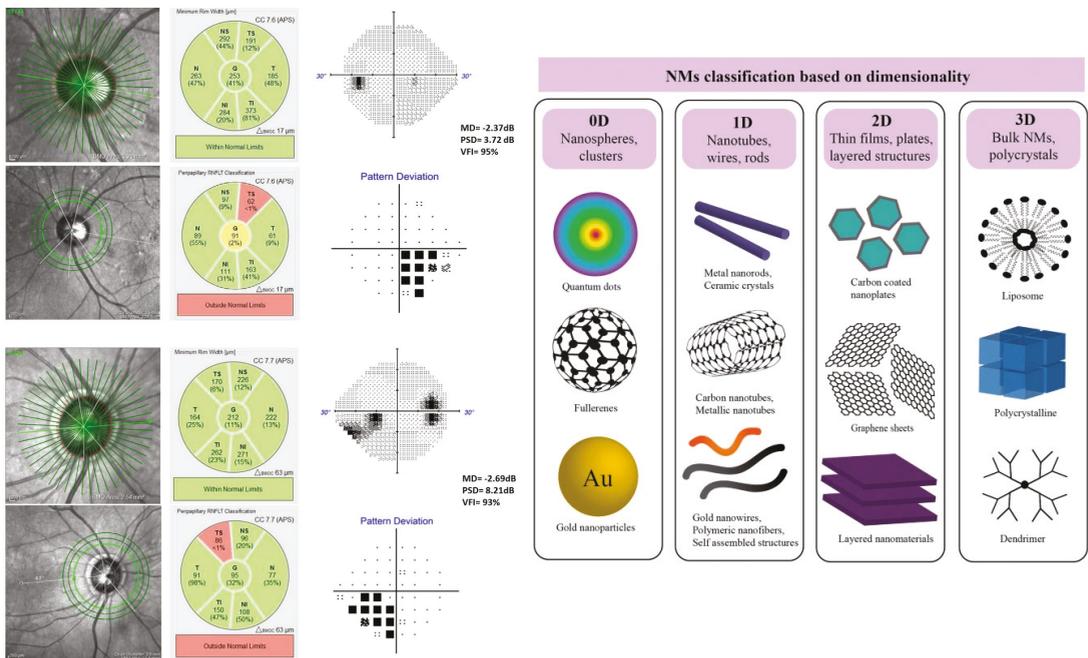


Figure 9. Juxtaposed collocational arrangements for classification, narrative and zoom-in combination [46,47].

Figure 6 gathers three vectorial compositions based on the use of arrows (replaceable by lines). Vectors (here arrows) can be seen to perform three major functions: mark a narrative in which there has been some change in state or condition (i.e., differentiate a 'before' from an 'after'), signal the reading or viewing path through the several stages of a process or procedure, and classify items from a superordinate category, indicating their derivation or exemplifying function.

Visual displays of various sorts (Figure 7) make up another frequent compositional pattern that entirely depends on editorial policies. Visual data in the form of graphs/charts and diagrams may appear as a minor element within a larger pattern or constitute a major one themselves, although such cases do not abound owing to the ever-increasing request for originality and creativity on the part of publishers and journal editors. This requirement tends to exclude the reproduction of graphics present in the article and to foster

eye-catching compositions, but few journals caution against the risks of certain practices adopted for that purpose, such as colour saturation and cluttered visual arrangements. Elsevier's *Cell* is one of those few journals.

With or without vectors, the amplifications of detail, which I termed 'zoom-ins' in a previous work [3], normally lean on collocational and framing resources and are reserved for the display of substructures or phenomena invisible to the naked eye. Both illustrations in Figure 8 employ stylised lense icons as frames, but the mere collocation of an unframed finer-grained picture usually suffices to understand the visual progression.

Last but not least, classificatory arrangements through juxtaposed collocations and with or without verbal labels (Figure 9) are an alternative to tree diagrams, although they may be mistaken for vectorless collocational narratives. The category or type, usually on top position, may be represented by a verbal label or a visual (labelled or not), below which subcategories and examples are placed. The same organisation may apply for progressive zoom-ins and narrative denouements in successive phases.

Since the beginning of 2021, Elsevier has changed its GA submission policy and demanded a unique compositional scheme consisting of three consecutive panels (see Figure 10) for the rhetorical moves of 'research contextualisation', 'methodology' and 'outcome', in order to curb the insertion of extraneous material and subjective metaphorical conceptualisations and set more universal graphic conventions.

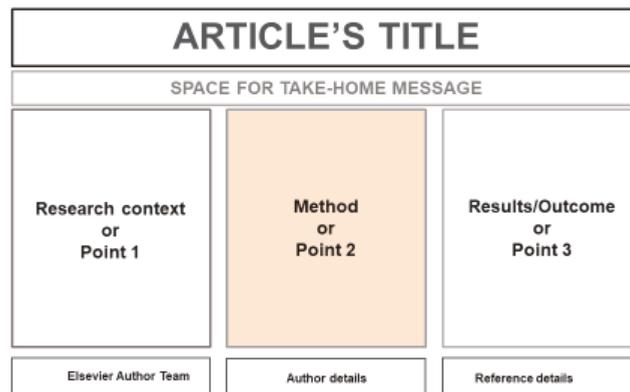


Figure 10. Elsevier's three-panel compositional proposal (rendition of the publisher's free-download original).

The idea is that readers/viewers grasp the article content 'at a single glance', but the four exemplars provided are not as lean as they should be for immediate visual capture. Only time will tell whether this goal will be eventually attained and whether modality markers and metaphorical embodiments will permeate the tripartite frame.

4. By Way of Conclusion: Towards Established Rhetorical Stylisations?

Elsevier's recent option for a three-panel model as single compositional pattern seems intended to fight stylisation through limitation and simplification, in the pursuit of more objective and universal patterns. The compositional arrangement chosen functions as an interactive metadiscourse item that marks three distinct stages in the scientific IMRD narrative and indicates the reading path to follow (left-to-right) without the aid of vectors. Yet this fair and economically democratising measure has its flipside: if compositional layouts express authorial voice, then the imposition of a single rhetorical scheme by publishers and journal editors may be accused of stifling individual creativity and dissuading authors from exploring pictorial possibilities that might generate knowledge. We must not forget that, in

Kress' words, "representation makers are knowledge makers" [33] (p. 27), and learning is "a dynamic process of sign making" not necessarily dependent on verbal language.

Tripartite exemplars, moreover, remain uncommented and, in consequence, scholars cannot learn from their design weaknesses nor incorporate valuable strategies from others to their own graphical repertoires, at least at a rhetorical macrolevel. Granted, templates may become 'editorial rhetorical stylisations' that define a journal or a publisher's identity, but at the expense of authorial choices and perhaps of the discipline's visual distinctiveness, because not all journals reflect what scientists do when disseminating knowledge and journal guidelines are not always followed by scientists. Furthermore, the very moment a stylisation becomes established and used across the board, it ceases to be a stylisation and evolves into a standard, from which new stylisations may stem.

A threefold challenge lies then ahead for further research: first, it will have to find out if the visual rhetoric conveyed by this tripartite template curtails subjectivity in favour of textual comprehension, and thus helps democratise scientific content. A full understanding of this content by lay audiences is, of course, asking too much in many disciplines, but it is not impossible to increase clarity for experts from akin fields and for communication and discourse analysts. Second, it will be necessary to investigate how much influence the template exerts among related journals, which might adopt the same model and turn it into a 'disciplinary rhetorical stylisation' (rather standard) and tool. The imposition, circulation and consumption of discourses always involve power issues, in this case, intra- and interdisciplinary, between scholars and their audiences (intended and untargeted), and between multinational publishing giants and the scientists' population. Third, visual corpora will need to be scrutinised to determine whether the newly acquired template will keep free of distracting elements and subjective modality devices that go against clarity, economy and immediacy. Let us wait and see.

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Notes

- ¹ <https://www.peta.org/blog/umass-simulates-hot-flashes-in-marmosets/> (accessed on 4 November 2021)
- ² <https://tocrofl.tumblr.com/> The acronyms stand for "Table of Contents-Rolling on Laughing Floor". This blog has been inspired in turn by other blogs in the science news outreach magazine *Discover* (<https://www.discovermagazine.com/>; <http://blogs.discovermagazine.com/discoblog/category/ncbi-rofl/>) (accessed on 4 November 2021)
- ³ <https://tocrofl.tumblr.com/> The acronyms stand for "Table of Contents-Rolling on Laughing Floor". This blog has been inspired in turn by other blogs in the science news outreach magazine *Discover* (<https://www.discovermagazine.com/>; <http://blogs.discovermagazine.com/discoblog/category/ncbi-rofl/>) (accessed on 4 November 2021)

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Article

The Parascientific Communication around Didier Raoult's Expertise and the Debates in the Media and on Digital Social Networks during the COVID-19 Crisis in France

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Abstract: Didier Raoult has acquired media authority in the debates on the treatment of COVID-19 in France thanks to his professional competence, raising issues of legitimacy and authority. He presents himself as a “star of infectious diseases”, belonging to the “elite”. In the press and online comments, the scientificity of the subject is mixed with considerations that may seem trivial. This paper will analyze the way in which scientificity is expressed in the media coverage of the scientist but also the way in which online communities discuss, argue, and become involved in polemics and controversies concerning him. It will analyze the links and shifts between scientific and parascientific communication. It will, therefore, deal with both the discourse and the staging around the scientist Didier Raoult and the circulation of his words and positions through online media and citizen communities.

Keywords: discourse analysis; digital humanities; textometry; authority; legitimacy

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1. Introduction

Didier Raoult has acquired media authority in the debates on the treatment of COVID-19 in France thanks to his professional competence, raising issues of legitimacy and authority. He presents himself as a “star of infectious diseases” (see, for example, *Le Soir*, 2 June 2020), belonging to the “elite”. Several long interviews have given Didier Raoult a platform since March 2020 and, in particular, during the period of lockdown in France. In one of them (LCI, 27 May 2020), for example, Didier Raoult is presented as an “iconoclast virologist from Marseille”, which already indicates the areas which this interview fits into: personality (“iconoclast”), profession (“virologist”), and geographical origin (“from Marseille”). The scientificity of the subject is mixed with considerations that may seem trivial which will be of interest in this article. This paper will analyze the way in which scientificity is expressed in the media coverage of the scientist but also the way in which online communities discuss, argue, and become involved in polemics and controversies. Noting that scientific disagreements quickly turn, in the public space and sometimes in the media, into polemics and conflicts, we will try to observe the links and shifts between scientific and parascientific communication and examine the boundaries between scientific, parascientific, and activist communication. This paper will, therefore, deal with both the discourse and the staging around the scientist Didier Raoult and the circulation of his words and positions through online media and citizen communities.

2. Materials and Methods

As the objective of this article is to analyze the discourse of a controversial scientist and the media, social reactions, and parascientific discourses around these controversies, I gathered a heterogeneous corpus [1] composed of documents of two genres revolving around a “discursive moment”. For [2], “insofar as the aim is to follow current events at the moment of their actualization, this involves resorting to successive “small corpora”, even when dealing with a long-term event. This leads us to compare the history of this

pandemic between different countries and different “discursive moments” and to examine the way in which the “information narratives” of the written press work.”

Bearing this in mind, I focused on a specific discursive moment (the first week of June 2020) in two specific actualization contexts: the press and social networks (Twitter). This period corresponds to a moment of controversy, as two scientific studies—one published in the scientific journal *The Lancet*, the other called “Recovery”—reached opposite conclusions on the use of hydroxychloroquine, followed by a retraction from the researchers behind *The Lancet* article in favor of using the drug.

These two publications are:

- (1) Mehra, M. R., Ruschitzka, F., & Patel, A. N. (2020). Retraction—Hydroxychloroquine or chloroquine with or without a macrolide for treatment of COVID-19: a multinational registry analysis. *The Lancet*, 395(10240), 1820.
- (2) Horby, P., & Landray, M. Low-cost dexamethasone reduces death by up to one-third in hospitalized patients with severe respiratory complications of COVID-19 [Internet]. RECOVERY Trial, 2020.

This very complex scientific subject (efficacy of a treatment, test protocols, validation of scientific trials) is thus discussed in the media and social media, producing reactions, comments, and, indeed, judgements without the protagonists necessarily having all of the elements or the necessary skills to form a judgment. In the French context, these publications had a very strong echo due to their media coverage, since Professor Didier Raoult, a French microbiologist specializing in infectious diseases and, at the time, director of the IHU in Marseille, received a lot of media attention for his very confident statements on the effectiveness of this treatment. This gave rise to many discussions and controversies, particularly during the periods of lockdown, which gave these debates a very large scope and resonance. The two “small” corpora under study are presented in Table 1:

Table 1. Description of the two corpora.

Press corpus	Social media: comments on an interview by Raoult
Articles published between 1 June and 7 June on Factiva (excluding Agence France Presse) on the keywords “Didier” + “Raoult”, a total of 89 pieces	604 Tweets written about the BFM TV interview with Ruth Elkrief and Margaux de Frouville on 3 June 2020 (Tweets posted on 3 and 4 June 2020 containing the keywords “raoult” + “bfm” and the replies to these Tweets)

The advantage of working on a “small corpus” is explained in [3]: a small corpus makes it possible to “identify language forms that are not necessarily “frequent”, in the statistical sense of the term, but “emergent” forms which reflect the present time”; and this corpus “makes it possible to “set a date” in history”. On the more precise choice of these two types of data, I refer to works that deal with press and tweet corpora in order to take into account precisely the stakes of these two kinds of discourse and of the devices in which they are integrated.

With regards to the press, ref. [2] has shown that “the observation of corpora collected over successive “moments discursifs” of the COVID-19 pandemic in the French media . . . leads us to question the “meaning” that the discourse gives to words and figures in their quotations and contexts in the course of the news, as well as the “social meaning” that the media discourse builds around this pandemic”. For the author, the form and meaning of information narratives are important in understanding “the reconfiguration of the theme of confidence” (for example, “discussion of state and institutional policies, distrust or mistrust of ordinary citizens but also of the traditional political parties”).

With regards to social media, ref. [4] shows that “exploring the topics of discussion on Twitter and understanding which ones are controversial is extremely useful for a variety of purposes, such as for journalists to understand what issues divide the public or

for social scientists to understand how controversy is manifested in social interactions". From a methodological point of view, works such as [5] have shown the advantage of a "method combining large-scale network and lexicometric analysis to link identifiable communities of Twitter users with the main discursive themes", and this analysis confirms that "political engagement and cultural dispositions are keys to understand[ing] different attitudes on Twitter".

To analyze this corpus, I combined two approaches (methods) whose theoretical linking I presented in [6]: discourse analysis and digital humanities.

Concerning discourse analysis, generally speaking, "the common ground of discourse researchers is that they understand discourse as a complex object that can be studied from various angles" [7] (p. 6). Discourse analysis is based, in particular, on a critical tradition stemming from the analysis of discourse *à la française* as defined by [8] (p. 14): "[f]rom 1969 onward, Foucault discovered that discourse is about more than isolated abstract signs. If discursive activity is now conceived of as the creation of networks or discursive formations of utterances, it is this theoretical shift towards the problem of the enunciation that has made the analysis of discourse possible." Thus, the corpora that we will look at in order to grasp the subject at hand will have to be analyzed both linguistically and semantically but also contextually and ideologically, which will influence the method of analysis used. To go further and clarify my position, I quote [7] (pp. 2–3): "Discourse Studies is an extremely heterogeneous field involving scholars from a range of disciplines"; and "Discourse Studies does not consider meaning as a given which can be read off the textual surface and reconstructed in spontaneous acts of understanding . . . discourse analysts study the way the social order is constructed in discursive practice"; they are interested "in the practices, rules, or mechanisms that can explain how meaning is negotiated between the members of a discourse community". It will, thus, be necessary to contextualize the meanings observed in the corpus and to analyze not only the manifestations of meaning but also the mechanisms of its construction. That is why I used digital humanities and, more precisely, textometry. To summarize my previous work, I refer to [9]: textometry, a branch of textual statistics, offers an instrumented approach to corpus analysis, joining up quantitative syntheses and analyses of text [10]. Functionally, textometry implements differential principles. This approach highlights similarities and differences observed in the corpus according to the representation dimensions considered (lexical, grammatical, phonetic, prosodic, etc.) and establishes contextual and contrastive modeling. It is, therefore, well suited to the challenges of discourse analysis that I have highlighted. For this paper, I used the Iramuteq software, which offers a set of analysis procedures for the description of a textual corpus (Iramuteq is downloadable at <http://www.iramuteq.org>, (accessed on 20 January 2022) and comes with extensive documentation and case studies. More precisely, Iramuteq is an interface for R, which can be used to make multidimensional analyses of texts and questionnaires). One of its principal methods is Alceste. This allows a user to segment a corpus into "context units", to make comparisons and groupings of the segmented corpus according to the lexemes contained within it, and then to seek "stable distributions" [11]. These groups are represented using hierarchical descending classifications (HDC). This method allows users to map out the dynamics of the discourses of the different subjects engaged in interaction [12]. The vocabulary of the corpus is "used to build a double-entry table listing the presence/absence of the full forms selected in/from the segments; a series of bi-partitions are [then] performed on this table based on a factorial analysis of correspondences". This construction establishes relations with three types of entities [11]: "(a) the terms (in columns); (b) the propositions (in rows); (c) the corpus (the table)", which joins the three levels of analysis "also evoked by Peirce in his triadic division of the 'symbols' (i.e., the conventional 'signs' of which the language productions are a part)", namely, the "terms", the "propositions", and the "arguments". Finally, this model aims at "mapping" the main topical foundations, or "topoi", on which this world of discourse is constructed by enunciators.

These classifications allow us to understand the themes of a corpus through the lexical worlds that compose them.

Before starting to analyze the corpora, it is necessary to consider the relationship between communication and science. According to [13], publications “which we call ‘parascientific’ are distinctive in that they seek to communicate to an audience both within and outside the formal scientific community”. They quote the anthropologist George Marcus who used the prefix “para” to highlight “how ambiguously alternative perspectives emerge amid moderately empowered people involved explicitly with major institutional powers” [14] (p. 5). For them, this prefix “locates parascientific publications alongside peer-reviewed scientific journals”, and they identify “parascientific media as an influential genre” in order to “explore the epistemic cultures of those who are neither acknowledged experts nor disempowered actors” (reporters, editors, and board members of parascientific media). In terms of discourse analysis, this is very interesting, as it relates both to questions of authority/legitimacy (which may refer more to questions of enunciation, ethos) and to questions of discourse genres and their textual norms. Their work is, thus, original, because they focus on “how certain forms of media deliberately intervene in technical knowledge as it travels beyond its supposed site of production”, thus taking a different view from that according to which science and the media are two distinct institutions; the authors point out that “because these publications are designed to orient attention to their content rather than their editorial processes, their role as agents in actively coordinating those exchanges, and not just as arenas in which they take place, is often rendered invisible”. To complete this, and to go more specifically to the context which interests us, it is also worth taking into account the work of [15], which shows that, regardless of the challenge to the notion of linear scientific progress, there is no doubt that scientific knowledge is growing fast; however, whilst “the process of accumulation taking place in scientific disciplines is widely studied . . . the way in which information accumulates and knowledge grows in non-scientific areas is less known”. In her book *Science Communication Online: Engaging Experts and Publics on the Internet*, [16] looks “specifically to microblogs, Wikipedia, and an online database of radiation contamination readings as emerging forms of science communication online”. She expands the work of [13] by putting forward the notion of “parascientific genres”. For her, “the importance of a conversational model of science communication should not be underestimated.”

Among the genres that contribute to the dissemination of scientific information without falling directly under the scientific category, journalistic discourse is a good example, especially in contexts such as health crises that generate a large amount of information. According to [17], journalistic discourse has two aims:

- “an ethical aim to transmit information in the name of democratic values: citizens need to be informed so that they can take part in public life”;
- and a commercial aim to attract the largest possible number of readers, listeners, and viewers.

According to him, this gives rise to two issues at stake: “credibility” (treat information “in the most credible way possible”) and “capture” (“treat information in such a way as to capture the largest possible number of receivers”). We can thus see how, in science, these two issues can sometimes clash and provoke complex reactions online. Furthermore, on the subject of scientificity, ref. [16] notes that “parascientific genres . . . borrow scientific authority and knowledge structures from the realm of science, but they operate outside the conventional models of gatekeeping and reporting found in internal science communication”. Thus, despite its declared ethical aim, press discourse cannot guarantee the same scientific validity as the scientific genres themselves; this can create gaps in information but also in reception, since not all readers have the scientific knowledge required to understand the issues covered by an article: “parascientific genres borrow some features from the internal discourse of science without the whole complex of features upon which the epistemic authority of science depends” [16]. The controversies on social networks also support the idea that there is a scientific ideology, as described by [18] when discussing an open letter

published in the French newspaper Le Figaro and signed by 40 prominent scientists. This letter, they state, is an example of scientific ideology, which also displays some propaganda features: “some of the elements of scientism and propaganda are used in order to support a political conception of institutional science as the only serious source of knowledge.”

3. Results

In this section, I will present the successive analyses of the two subcorpora using the method described in Section 2 above. In particular, I will detail the lexical classes by providing representative examples. Drawing on these two analyses, I will then be able to examine issues pertaining to the parascientific communication around the figure of Prof. Raoult in the discursive moment chosen.

3.1. Media Articles about Didier Raoult

Using the Iramuteq software, I applied the Alceste method—presented in Section 2—and obtained the dendrogram presented in Figure 1:

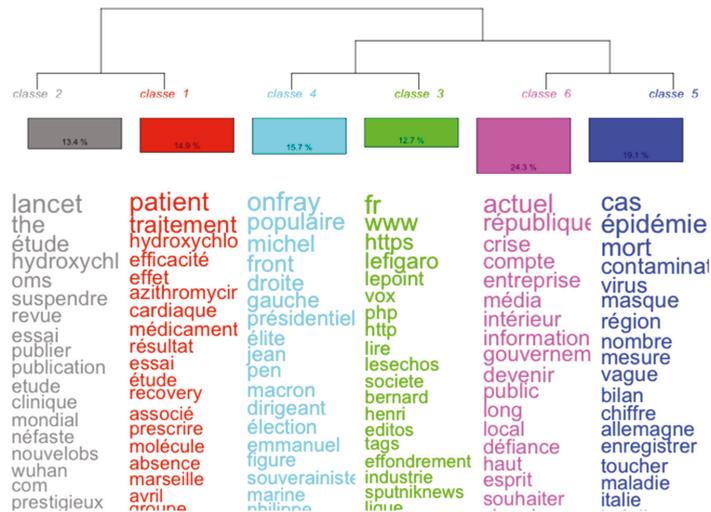


Figure 1. HDC of the press corpus.

These classes were, therefore, derived from a statistical classification which brought together terms that were close to each other. Looking closely at the terms grouped in the various classes and reading the text segments that led to these groupings, we chose to focus on three particular classes (which correspond to clusters of terms that refer to actual topics, rather than communicational or contextual aspects):

- Class 1 (14.9% of text segments), which contains texts about the efficacy, effects, and results of hydroxychloroquine, the drug advocated by Prof. Raoult;
- Class 2 (13.4% of text segments), which discusses the scientific validation (in journals such as *The Lancet*) of the study and whether or not the drug should be authorized for treating patients;
- Class 5 (19.1% of text segments), which deals with the epidemic and numbers (using words like “cases”, “deaths”, etc.).

Looking at these three classes will help us to see the way in which Prof. Raoult and his work have been presented in the press.

In the Iramuteq program, it is possible to select “characteristic text segments” which are the most representative of a given class (as they contain the most words belonging to that class). In the case of Class 1, three examples are good illustrations of what the press has

to say about the subject (the analyses were done on the French corpus, but the examples are translated into English):

(1) *Chloroquine mega-study impossible to verify after all. Hydroxychloroquine has “no beneficial effect” in COVID-19 patients according to British Recovery Trial leaders, who yesterday announced an “immediate” halt to the enrolment of new patients for this treatment. The first major clinical trial to produce results, it was one of the few not to suspend hydroxychloroquine tests in the wake of the study in The Lancet. The trial is controlled and randomized (patients are selected by drawing lots), which is considered the most robust method. It has been conducted in the UK on over 11,000 patients from 175 hospitals in order to assess the efficacy of several COVID-19 treatments. Tests on options other than hydroxychloroquine continue.* (Var Matin, 6 June 2020)

In this section, we note the use of quotation marks to present the point of view of scientists whose conclusions contradict those of Prof. Raoult. This distancing is also supported by the phrase “considered the most robust method”, which endorses, and gives credibility to, the information conveyed by the article. Another article chooses to detail the conditions in which the study published in *The Lancet* was conducted and questions its veracity (and, therefore, the arguments against the efficacy of hydroxychloroquine):

(2) *The findings of the study published in The Lancet cover a total of 96,000 patients, all infected with COVID-19, who were admitted to 671 hospitals on six continents between 20 December 2019 and 14 April 2020. Of these, 15,000 patients split into four groups were treated with the drug, either alone or in combination with others. The results of the study on the non-efficacy of hydroxychloroquine in the treatment of COVID-19 as recommended by Prof. Didier Raoult, published by the prestigious British scientific journal The Lancet, have had a worldwide political and health impact.* (El Watan, 6 June 2020)

The article highlights the prestigious nature of the journal and seems to emphasize the method (using a series of figures), which gives credence to the opposition to the treatment advocated by Prof. Raoult. This methodological argument is further detailed in the following excerpt, which clarifies the concept of evidence-based medicine (EBM):

(3) *The controversy over the benefits of chloroquine or, more precisely, hydrochloroquine in the treatment of COVID-19 concerns the experience of Professor Didier Raoult of the Hôpital de la Timone Laboratory in Marseille. According to his results, hydrochloroquine, combined with azithromycin, apparently has a positive effect in COVID-19 patients. . . . Criticism of this approach, both by French doctors and by national societies in other countries and international medical societies, relates to the study design used by Prof. Raoult, which does not follow the rules of “evidence-based medicine” (EBM). In the series treated in these experiments, there was no control group and no randomization of patients, on the grounds that this was an emergency treatment in the absence of other therapeutic alternatives. Furthermore, the criteria for including patients were not clearly defined. The results obtained cannot, therefore, be reliable according to EBM. Above all, they have never clearly demonstrated that there is a significant reduction in mortality. The reduction in the viral load and the improvement in symptoms detected in Prof. Raoult’s experiment are not enough to affirm the efficacy of this therapeutic regimen.* (Libération, 2 June 2020)

The use of the adverb “apparently” at the beginning of the paragraph casts doubt on the beneficial effects of this drug, and what follows makes this explicit: “does not follow the rules”, “cannot, therefore, be reliable”, “are not enough to affirm”.

In the case of Class 2, the articles again tell the story of this controversy, but they also include the news that trials of this drug have been resumed, thus offering a more positive overall view of Prof. Raoult’s treatment:

(4) *Published on 22 May, this study—which came after several others in the same vein—had concluded that hydroxychloroquine was not beneficial for hospitalized patients and could even have a significant harmful effect (see our 24 May issue). Its publication had caused a global stir and had spectacular repercussions, such as prompting the WHO to suspend clinical trials for this treatment. But in the end, after much criticism of the study’s methodology, including from scientists who were skeptical about the benefits of hydroxychloroquine, the WHO announced on Wednesday that it would resume clinical trials of this drug.* (Var Matin, 6 June 2020)

The narrative is well constructed, using several tenses and a “punchline” that is intended to be favorable, whilst relegating to the background (between hyphens) elements that are rather unfavorable (“which came after several others in the same vein”). This is perceptible in example 5, which also uses several tenses:

(5) *During a video conference, the WHO Director said: “On 25 May, the global health authority had announced the suspension of hydroxychloroquine trials following the publication of a study in the medical journal The Lancet which found the use of chloroquine or its derivatives, such as hydroxychloroquine, against COVID-19 to be ineffective and even harmful.” He added: “The suspension of the trials was to allow the WHO to analyze the information available, and a decision was expected by mid-June.” In the end, the decision came sooner than expected, since, at Wednesday’s press conference, the WHO announced that the trials would resume. “We are now fairly confident that we have not seen any differences in mortality,” Soumya Swaminathan, the WHO’s Chief Scientist, told a news videoconference held at the organization’s headquarters in Geneva on Wednesday.* (El Watan, 6 June 2020)

Thus, Classes 1 and 5 discuss the validity of hydroxychloroquine, with a negative focus (*The Lancet* study) or a positive one (WHO recommendations), which shows the polarization of the debate.

Text segments in Class 5 are more factual, containing lots of figures (example 6), developments/trends (examples 6 and 7), or conclusions about the figures:

(6) *Yesterday, Brazil passed the milestone of 30,000 deaths due to the coronavirus, but the country’s sharp rise in the number of cases has not deterred Rio de Janeiro or Sao Paulo from beginning to come out of lockdown. The country suffered another 1262 deaths, the worst daily toll since 21 May (1188), the health ministry said. Brazil, a country of 212 million people which accounts for more than half of coronavirus infections and deaths in Latin America, has recorded 555,383 confirmed COVID-19 cases, following yet another sharp rise of almost 29,000 infections in 24 h. These figures, which the scientific community believe to be grossly underestimated, place Brazil fourth in the world in terms of deaths, behind the US, UK, and Italy.* (Sciencesetavenir.fr, 3 June 2020)

(7) *With the decrease in the number of confirmed cases and the number of deaths varying between 6 and 8 compared to the beginning of the pandemic, some wilayahs are seeing large numbers of cases compared to other regions in the country.* (El Watan, 6 June 2020)

(8) *These are targeted surveys to monitor new cases in these areas and break the chain of infection. Epidemiology teams are already on the ground to identify all these cases, which generally occur as a result of easing precautionary measures and in particular failing to observe physical distancing.* (El Watan, 6 June 2020)

We can thus conclude that the press presents the controversy surrounding Prof. Raoult by providing a chronological account of his medical recommendations, which it integrates into a fairly slanted narrative, even if certain parts of the articles are more factual. It also stages the controversy between several studies, focusing on either the questioning of *The Lancet* study or the WHO’s validation of the trials.

In order to study the way in which these press discourses are disseminated, I propose to now look at reactions on Twitter to a specific interview with Prof. Raoult and, thus, to gauge the particularity of this type of communication.

3.2. Twitter Comments on Didier Raoult's Interviews

The following explanation by [16] touches on the importance of turning our attention to this corpus: “[t]hese forms of online science communication offer valuable insights for rhetorical scholars interested in how genres of communication evolve and change.” Indeed, we need to take into account “the complexities between highly codified spheres of discourse, rapidly evolving public discourse, and the intersection of media change”. In order to follow and apply this suggestion, I propose a linguistic study of 604 Tweets written about a BFM TV interview given to Ruth Elkrief and Margaux de Frouville on 3 June 2020 (presented in Figure 2). BFM is a 24-h news channel which has given a lot of media coverage to the pandemic and has also contributed to the appearance of medical experts on television. It is, therefore, a good illustration of the importation of scientific discourse into the media sphere—and the problems that this can pose—in the context of an interview on a very specific subject aimed at the general public.

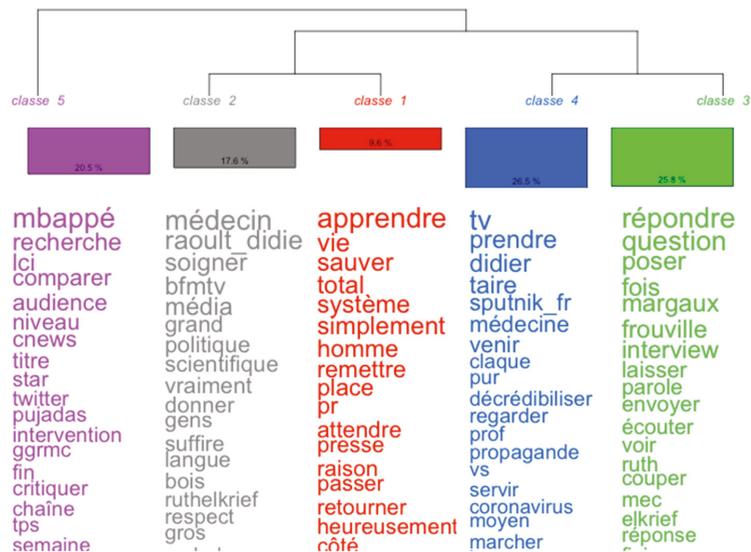


Figure 2. HDC of the corpus of Tweets.

This classification highlights messages that can be grouped based on the following themes:

- Class 5: the comparison with the footballer Mbappé and its consequences;
- Classes 3 and 4: conflicts sparked by the interview, whether with the journalists or, by extension, with the media in general;
- Classes 1 and 2: appreciation for Professor Raoult or discussion of his competence.

Taking a closer look now at the corpus, we can see how commenters give accounts of a long interview bearing on the scientific dimension of the controversy. Twenty per cent of the comments deal with Didier Raoult’s status as a “star” (Class 5) in relation to the comparison with the footballer Mbappé:

(9) **** *2020-06-03 *tweet263

Maybe one day BFM will stop rolling out the red carpet for him . . . ratings clearly take precedence over journalistic interest. And the headline “Didier Raoult, the mbappé of research?” is jarring.

(10) **** *2020-06-03 *tweet401

they said raoult is the mbappé of research hahaha bfm comes up with the best headlines

(11) **** *2020-06-04 *tweet18

No it's not true what he says! "mbappé of research" was used by BFM. Raoult said you are not going to compare mbappé with a 3rd division goalkeeper. He particularly wanted to emphasize the ignorance of scientists, researchers in France drawing a comparison with footballers

These three examples deal with BFM TV's headline about this comparison, the legitimacy of this comparison, and the role of the media ("rolling out the red carpet", "ratings clearly take precedence over journalistic interest"). Indeed, in an attempt to point out the public's lack of understanding of the level and hierarchy of scientists, Prof. Raoult compared himself to the prestigious footballer Killian Mbappé, drawing an analogy with him in the field of research. These few examples show the polemical dimension found on social networks whenever he gives an interview. The social dimension becomes an element that needs to be taken into account when considering authority and legitimacy in digital spaces, since, although he is very well known institutionally, the "star status" which he has been staging seems to be subject to controversy or comments.

Twitterers' reactions help convey, consolidate, or challenge the legitimacy and/or authority of public figures during their media appearances. In Didier Raoult's case, some of the messages relate to a conflictual representation of the situation.

We can see that Classes 3 and 4, accounting for around 50% of the comments, focus on the conflict. Class 4 (a quarter of the text segments) includes messages from the @sputnik_fr account about the heated exchange between Didier Raoult and Margaux de Frouville. Thus, all messages share a similar form.

(12) **** *2020-06-04 *tweet91

"Shush, be quiet!": Didier Raoult lashes out at a BFM TV journalist: via @sputnik_fr

Here, "via @sputnik_fr" means that the @sputnik_fr account has retweeted messages posted by various Twitterers reacting to the same incident. According to the Wikipedia page on this media outlet, "Sputnik (. . . formerly Voice of Russia and RIA Novosti . . .) is a Russian state-owned news agency, news website platform, and radio broadcast service. It was established by the Russian government-owned news agency Rossiya Segodnya on 10 November 2014. . . . Sputnik is frequently described as a Russian propaganda outlet. . . . Sputnik operates news websites, featuring reporting and commentary, in 31 languages, including English, Spanish, Polish, and Serbian." These contextual elements are useful in terms of taking into consideration the socio-political aspects of the discourse and the enunciative anchoring; indeed, discourse analysis is interested in the points of view of the enunciators and takes into account the places occupied in the social space, particularly the media. Thus, these Tweets record the "clash" that occurred when Didier Raoult asked one of the interviewers to be quiet while he answered.

Several other examples relate the same episode but comment on it positively, siding with Prof. Raoult:

(13) **** *2020-06-04 *tweet35

Be quiet! Raoult vs Elkrief on BFM! Brilliant interview! via @YouTube

(14) **** *2020-06-04 *tweet32

When #Raoult tells the BFM journalist, "Be quiet!", he reminds us of 1 obvious fact: a professor of medicine speaking about his field is superior to a journalist. This is difficult to understand in an age of fanatical intellectual egalitarianism. But there it is.

(15) **** *2020-06-04 *tweet87

We may be shocked by a "shush, be quiet" (Raoult to @mdfrouville) but let's not forget that the daily symbolic violence perpetrated by the clique of BFM editorialists is infinitely more harmful than such indelicacy

In (13), the interview is appreciated for being hard-hitting; in (14) the user recognizes the professor's superiority; and in (15) the verbal violence is excused by pointing to the

symbolic violence perpetrated by the media. Class 3, which is close to Class 4 discussed above, also deals with the interactions between the scientist and the journalists, this time pointing out either the latter's strategies for asking questions or their behavior during answers:

(16) **** *2020-06-04 *tweet126

@LeMediaTV I must be dreaming. Watching 2 BFM journalists interviewing Raoult and trying all along to trap him. Their technique: ask a question and not let him answer it so as to confuse the audience. Is this what we call journalists?

(17) **** *2020-06-03 *tweet350

Long live Professor Raoult long live Marseille we have the best professor these BFM TV journalists are seriously starting to get on my nerves frankly they are really shit journalists and I support Didier Raoult he is a good man long live Marseille long live Didier Raoult

(18) **** *2020-06-03 *tweet425

The live interview on BFM with Professor Didier Raoult is irritating, when he starts to answer their questions they immediately cut him off, whenever he tells them "I am speaking don't interrupt me" they dare say "it's an interview", bitches

The Tweets in this class sometimes display a degree of verbal violence (insults and abuses such as "shit journalists" in (17) and "bitches" in (18)). The virologist is also defended in other messages which legitimize him in different ways. Thus, the messages in Classes 1 and 2, which represent just over a quarter of the corpus, highlight either his pragmatism ("meanwhile he is saving lives") or his opposition to the system. They record the exchanges about the medical field and treatments; these messages particularly emphasize his supposed "anti-system" trait and his personality.

In Class 1, we find Tweets such as:

(19) **** *2020-06-03 *tweet271

He is right, since the beginning of the epidemic the government and BFM have discredited him, taken him for a charlatan, what do they do while he saves lives? Full support for Mr @raoult_didier people don't like to hear the truth, I hope he will be able to prove he was right

(20) **** *2020-06-04 *tweet152

it's the #BFM journalists who stink. #Raoult saves lives, is internationally recognized and these attack dogs treat him like a clown, ask him questions and ignore his answers. That's how they behave with anyone who is not in their ultraliberal camp

(21) **** *2020-06-04 *tweet148

No, it's logical that his supporters are enjoying this: he's doing exactly what they expect of him, he's the man who will have "put big pharma in place together with the Judeo-Islamic-Bobo-Illuminati journos under Macron's heel" and "who says out loud what we actually think of BFM WC".

Twitterers show their support by using words such as "support" (example 19), "is internationally recognised" (20), and "the man who will have put big pharma in place" (21). However, whilst voicing their endorsement on the medical side of things, they also bring up politics ("ultraliberal camp" in (20)) and even conspiracy theories ("the Judeo-Islamic-Bobo-Illuminati journos under Macron's heel" in (21)).

Other messages focus on his legitimacy, especially in relation to the interviewers: over 17% of messages (Class 2) concern the professor's credibility (mainly good, sometimes bad) and the appropriateness (or not) of giving him a media platform. Here are a few examples of positive views:

(22) **** *2020-06-03 *tweet495

The guy is a professor of infectious diseases and Ruth Elkrief is giving him lessons in medicine . . . sure. #BFM #Raoult

(23) **** *2020-06-04 *tweet83

*Yes, be quiet you sh*t hack who wants to teach the great @raoult_didier about science . . . BFM really makes you want to puke..!!!*

These examples show that he is seen as legitimate and should not be contradicted by a journalist (who is pejoratively called a “hack”). The term “lessons” indicates that his position is that of a master, despite his being contradicted. More broadly, though, we see from the tone of these messages that disagreements about science quickly turn into polemics and conflicts.

4. Discussion

The two corpora compiled around a specific discursive moment show that there is variety between media communication and communication on social networks; of course, this “gap” between two discursive practices is understandable, but, “content” gaps aside, it is the communicational gaps that are of more interest in this article. Indeed, within each of these genres we see divergences, in terms of what is said about the information, but also the forms that discourses can take, which raises questions about the very principles of parascientific communication.

By comparing discussion genres in relation to Prof. Raoult—the press and Twitter comments—we have identified salient features of each of these genres as well as discursive, communication, and argumentative differences. The controversy in the press surrounding Prof. Raoult provides a narrative that presents the specialist in a relatively axiologized way (positively or negatively); on Twitter, users point to disagreements about science, and discussions quickly turn into polemics and conflicts. We have also noted markers of reported discourse (quotation marks), qualifications (the journalist’s point of view), and the use of arguments of authority (prestige of publishers, figures), highlighting the sometimes paradoxical dimension of the press, which is attached to factuality but presents points of view according to certain conclusions or editorial orientations.

This corpus study is, therefore, important because it shows that:

- the press genre, despite the injunction to inform readers, also has certain leanings, which are evident not so much in the content as in the narratives provided to readers: what are the “ingredients” of the story, how is it staged?
- social networks are often blamed for spreading misinformation ([19,20]): for example, the report in [21] on “12 announcements by Facebook and five by Twitter aimed at reducing the circulation of misinformation on their platforms” between the 2016 election and 2019. In the present case, we sense a degree of violence towards the journalistic genre and, therefore, a conflict between the spheres of disseminating and constructing scientific knowledge; and, particularly in the context of scientific communication about health, we observe a polarization of points of view and also a transposition of the criteria of scientific authority (Prof. Raoult comparing himself to Mbappé, Tweets comparing the skills of the professor and journalists) and their impact (political dimension, questioning the media);
- information and opinion sometimes tend to be confused, and the instantaneousness of social networks should also be taken into account. That is why we have to consider the specific features of these kinds of discourse as well as the object of the polemics contained in them.

All of this argues for the need for a discursive consideration of parascientific genres; the previous points have highlighted the formal heterogeneity of the discourse genres considered, both internally (within each genre) and comparatively. However, given the differences in scientific knowledge and the porosity between scientific/media/social genres, we end up losing track of the source discourses and pass from information to polemics. We

have seen that certain enunciative markers in the press (inverted commas, modals) already blur the transmission of information by integrating a certain point of view; this blurring becomes more pronounced on social networks, even going so far as to become sedimented when the debates are extremely polarized. For example, on Twitter, quotes are more about “punchlines”, particularly offensive discursive sequences, than the reported presentation of factual elements.

Thus, parascientific communication can become activist communication. We have seen that, in the corpus of Tweets, some users mix political/conspiratorial considerations with statements about scientific credibility. To broaden the conclusions drawn about social media and their polemical dimension, I collected the Tweets (2177 as of 17 August) that used the hashtag #nous savons (“we know”), which is used by antivaccine users in general but is especially anchored in conspiracy theories (they are hiding this or that truth, but “we know”). I will not go into the subject of conspiracy theories, false information, etc., but I am interested here in looking at the form that these messages take. Indeed, they are very different from the messages in the corpus discussed in 3.2. Appendix A lists 35 of the 37 most frequent active forms in this corpus; we can see that these are hashtags most of which combine several words, being similar to small phrases or formulas.

Some of these hashtags reflect the number of people who identify with #nous savons and are linked to the various rallies that have taken place (including on 14 August, which is mentioned):

(24) #nous sommes des millions (“we are millions”)

(25) #nous sommes en nombre (“we are many”)

(26) #nous sommes des milliards (“we are billions”)

The examples above use the structure “we + are + indication of a great number”. In this respect, example 27 also bears similarities:

(27) #tous unis (“all united”)

A number of other messages have the form “no + preposition + noun + modifier” (“no + preposition + modifier + noun” in the English translation):

(28) #nonaupassdelahonte (“no to shameful pass”)

(29) #nonalavaccinationobligatoire (“no to compulsory vaccination”)

(30) #nonaupassdelahonte (“no to shameful pass”)

(31) #nonaupasssanitaire (“no to health pass”)

(32) #nonauvaccinobligatoire (“no to compulsory vaccine”)

Three relate to the health pass introduced in France in August 2021, which is either mentioned in a neutral way (“health pass” in (31)) or called “shameful” in (28) and (30) (there is some confusion about the French spelling of the word “pass”). Examples 29 and 32 refer to compulsory vaccines/vaccination (which is not the same as the health pass, since the latter can be obtained with a negative test or proof of having been infected with COVID-19).

Finally, there is a political side to a significant number of the hashtags used, as they express opposition to the French government’s decision, having a very polarized dimension and denouncing the “dictatorial” way in which the health pass or vaccination has been implemented:

(33) #boycottpasssanitaire (“boycott health pass”)

(34) #stopdictaturesanitaire (“stop health dictatorship”)

(35) #jenesuispasuncobaye (I am not a guinea pig)

(36) #resistance

(37) #gouvernementdelahonte (“shameful government”)

(38) #vouserezjuges (“you will be judged”)

With words like “boycott” (33), “dictatorship” (34), “guinea pig” (35), “resistance” (36), “government” (37), and “judged” (38), there is a clear move towards a politicized and even conspiratorial vision of the event, using hashtags that resemble political formulas or slogans.

Finally, there are two hashtags worth noting, as they follow an already much-used structure—“keep away from X”—which in this case relates to children/kids:

(39) #toucheapasamesenfants (“keep away from my children”)

(40) #toucheapasamesgosses (“keep away from my kids”)

Indeed, some of the objections raised concern the supposedly harmful nature of the vaccines for children.

Despite the diversity of these hashtags, it is notable that they are constitutive and representative of this new, highly polarized and politicized corpus. These results allow us, therefore, to point out an additional feature of parascientific communication on social networks: when it becomes radicalized, it is “condensed” into formulas or hashtags, which can be seen as signaling a move away from the scientific—and even parascientific—genre and towards propaganda discourse.

5. Conclusions

To conclude on the subject of the parascientific communication around Professor Raoult during a discursive moment of the COVID-19 health crisis, it appears that the attention given to a scientific debate by the press (efficacy of a treatment) or by social media (interview on the topic of health management) helps produce different narratives that present the events in different ways. In the absence of scientific points of reference, the press tries to report statements or developments, but it often takes an argumentative approach, which causes strong dissension and even controversy on social networks. This can lead—as in the political and polemical case of the health pass—to a blurring of the lines with the activist discourse. Generally speaking, this discursive moment reveals the whole complexity of parascientific communication, which diffusely mixes scientific, media, digital, citizen, and even activist types of discourse. This complexity is further exacerbated in the context of a health emergency such as the COVID-19 crisis and prompts us to take into account the various communication genres as necessary devices for transmitting and regulating information. Whilst a general scientific culture is, therefore, important to understand the issues at stake in a debate, a communication and discursive culture is also important in order to deal calmly with these discursive events and to take into account the otherness and diversity of points of view.

With regards to the question of knowing how parascientific communication differs from the scientific, our analysis shows the importance of taking account of the transposition from media to social media [22]: “individuals are turning to online platforms to learn about science and health topics, with the Internet dominating as the primary source of information about science and technology news.” From these social media, new discourse practices are emerging, not only in response to boundary erosion in scientific communication [22] but also because of the polarization and controversies in which citizens are involved ([22] points out that “37% of Facebook users regularly see news on Facebook about science and technology, and 46% see news about health and medicine”).

With regards to the exploration of new, scientific or parascientific practices, and, in particular, digital communication, [23] shows (in relation to the COVID-19 epidemic) “the critical impact of this new information environment”: “the information spreading can strongly influence people’s behavior and alter the effectiveness of the countermeasures deployed by governments. In this respect, models to forecast “viral spread” are starting to account for the behavioral response of the population with respect to public health interventions and the communication dynamics behind content consumption.” Thus, decoding

and analyzing the media and social media, as well as working on media education and the exercise of critical thinking, is all the more necessary.

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Appendix A

List of the most frequent forms used in the corpus of Tweets based on the hashtag #nous savons:

#nous savons ("we know")	2177
#nous sommes des millions ("we are millions")	653
#non au pass delahonte ("no to shameful pass")	615
#manif 14 aout ("demonstration 14 August")	335
#non a la vaccination obligatoire ("no to compulsory vaccination")	263
#tous unis ("all united")	208
#boycott pass sanitaire ("boycott health pass")	198
#non au pass delahonte ("no to shameful pass")	171
#pass sanitaire ("health pass")	163
#bfm menteurs ("lying BMF")	146
#medias menteurs ("lying media")	143
#ivermectin saves lives	141
#je ne suis pas un cobaye (I am not a guinea pig")	140
#trumprally	139
#the storm is coming	139
#patriotes	139
#laissez les medecin soigner ("let doctors treat [their patients]")	139
#god bless	139
#resistance	134
#non au pass sanitaire ("no to health pass")	134
#manifs 14 aout ("demonstrations 14 August")	129
#nous sommes nombreux ("we are many")	120
#non a la vaccination obligatoire ("no to compulsory vaccine")	109
#stop dictature sanitaire ("stop health dictatorship")	106
#gouvernement delahonte ("shameful government")	100
#vous serez juges ("you will be judged")	96

#passanitairedelahonte (“shameful health pass”)	89
#nous sommes des milliards (“we are billions”)	87
#stopaumassacre (“stop the massacre”)	80
#touche pas a mes enfants (“keep away from my children”)	74
#liberte (“freedom”)	69
#covid	61
#va (“go”)	60
#touche pas a mes gosses (“keep away from my kids”)	60
#manifestation14aout (“demonstration 14 August”)	60
#passdelahonte (“shameful pass”)	57

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Total SciComm: A Strategy for Communicating Open Science

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Abstract: This paper seeks to introduce a strategy of science communication: Total SciComm or all-out science communication. We proposed that to maximize the outreach and impact, scientists should use different media to communicate different aspects of science, from core ideas to methods. The paper uses an example of a debate surrounding a now-retracted article in the *Nature* journal, in which open data, preprints, social media, and blogs are being used for a meaningful scientific conversation. The case embodied the central idea of Total SciComm: the scientific community employs every medium to communicate scientific ideas and engages all scientists in the process.

Keywords: preprints; open science; science communication; social media; Total SciComm

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1. Introduction

Growing skepticism towards scientific findings makes capturing attention from the public an urgent and serious issue for scientists. The attention will help raise the scientists' profiles and provide scientists a channel to communicate through scientific ideas. On YouTube, and a new form of radio—podcast—the rise of the Intellectual Dark Web group is a prominent example of an effort for good and effective science communication [1]. However, mainstream science communication is still limited to conventional media like journalism or personal blog. In a world where “information strategy” is becoming more important [2,3], science communication needs to employ every tool possible.

The rise of social networking sites has coincided with a sharp decline in public trust in science. In 2016, only 21% of American adults reported a great deal of confidence in scientists. The ineffectiveness in communicating scientific truth to the public has traditionally been argued to result from the lack of ability of scientists. However, in a post-truth society [4], the core of the problem has now shifted toward the sheer availability and the contagion of misinformation and disinformation in modern digital media [5]. Improving public communication of scientific truth and combatting fake news are two sides of a coin in the vital battle to improve public epistemology. Society's failure to agree on a basic set of facts has been deadly, as shown in the COVID-19 pandemic [6]. While scientists are trained to think in abstract and statistical terms, the pandemic has revealed that humans have not evolved to seek a correct understanding of reality [7]. Rather, as shown in decades of research in evolutionary psychology and behavioral economics, humans are predisposed by evolution to have weak intuition about risks, to be prone to self-deception, to harbor confirmation bias, among many of our inherent and systemic flaws. Thus, the mission of scientific communication is not merely about presenting cold, scientific findings but also about how to generate healthy engagement with these facts [8] and prepare society for future threats with a more robust epistemological stance.

There have been multiple proposals and academic journals devoted to studying and advocating for innovative approaches in science communication [8–12]. For example, studying the success of Nerd Nite, which started as a series of informal scientific talks in a local pub in Brooklyn then spread to more than 100 cities in the world, Tan and Perucho (2018) propose that to reach a wider audience, scientists must bring science to the

people rather than let the people come to them. This means to rethink current outreach programs to focus on where the target audiences already are [9]. Contera (2021) reflects on science's central mission of public communication and proposes that to communicate a scientific story effectively, a scientist must: (1) investigate the origins; (2) disclose his/her plan and position; (3) inspire the audience and herself; (4) explore positive scenarios; (5) examine unintended consequences; (6) adapt one's language; (7) and contribute to the democratic process [8]. In a similar vein, Matta (2020) argues that science communication can be a preventive tool for future pandemics if science is effectively communicated by embracing interdisciplinary research, crafting an accessible narrative, making the science personal, and galvanizing citizen participation in the scientific process [13]. Indeed, it takes a huge amount of effort to get scientific facts across without backfiring. This entails an effective science communication strategy is to understand how to generate scientists' willingness and how the backfire effect happens. Besley et al. (2018) found that beliefs in public science communication make a difference, and self-confidence in communication skills make scientists more willing to engage. Thus, Besley et al. suggest it is worth showing the scientists results of their engagement efforts to enhance their willingness for public engagement [14]. To maximize the effectiveness of science communication, Friesen, Van Stan, and Elleuche (2018) suggest a framework to present the complexity of science in a friendly comic [10]. Peter and Koch's (2015) work on the backfire effect shows that bringing up a scientific myth to correct it might be a counterproductive strategy as people tend to misremember it as correct. However, if the backfire effect is reduced, people are asked to form an immediate judgment upon receiving the correct information [12].

As proposals to improve the effectiveness of scientific communication are diverse, this article proposes a unifying strategy for science communication, which is called Total SciComm or All out science communication. The strategy is total in three senses. First, the core idea of this strategy is to utilize every possible media to communicate every aspect of science. Second, to efficiently explore and use those media techniques, the scientific community must deploy all of its rigors and sophisticated methods to study what makes science communication effective. Third, similar to the Dutch's total football, scientists must acquire more skills and stamina for public engagement to implement the new science communication strategy. The next section will use a debate surrounding a high-profile case of a now-retracted Nature's article to illustrate how scientists communicate science in the open-access era. Then, we will explain the Total SciComm strategy in detail and how it can help expand the outreach of science.

2. The Seshat Debate

In March 2019, *Nature* published a study named "Complex societies precede moralizing gods throughout world history" [15]. For disclosure, the study was retracted on 7 July 2021, which we will go over in more detail [16]. The study presented a striking result that when the society developed in a complicated way, the role of moralizing gods became more apparent [15]. The study resulted from learning about the "moralizing gods" hypothesis with the large historical dataset Seshat. This hypothesis suggested that the belief in being judged by higher power would be a cultural continuation to control a large, complex development society. The scale of Seshat and sensational results instantly caught the public's attention, with *Science* or *ScienceDaily* covering the new findings [17,18].

Because of the open dataset, other research teams were able to re-analyze the initial results. Just two months after the original research was published in *Nature*, a critical review was posted by Bret Beheim and his collaborators on *PsyArXiv* on 2 May 2019 [19]. This manuscript stated that some factors of data processing and analysis methods had influenced the conclusions of the original publication. In retrospect, moralizing gods appeared before complex societies. One day after the critical paper of Beheim et al. [19], another manuscript from Slingerland et al. also showed concern about the encryption process to the amount of historical data [20].

The corresponding author of the study on moralizing gods responded to the critical analysis of Beheim and his partners shortly after that, on 5 May 2019, with a blog posted on Nature Ecology and Evolution Community [21]. The Seshat team intended to publish a formal rebuttal [22] to Beheim et al. [19]; however, the preprint was withdrawn. On the same day, veteran researchers Harvey Whitehouse and Pieter Francois, the founding directors of Seshat Databank (with Peter Turchin), also shared their opinions regarding the criticisms on a blog post [23]. Bret Beheim also used his blog to discuss further the technical problem of the moralizing gods paper [24].

To respond to the criticism of Slingerland in [20], a rebuttal and an introductory paper from the Seshat team were expected to be published in the *Journal of Cognitive Historiography* altogether. However, it was not until November 2020 that all three articles, the Slingerland et al.'s criticism, the rebuttal, and the introductory paper of the Seshat database, were finally published [25–27]. Back in 2019, with the editorial permissions, the Seshat team posted the Slingerland rebuttal and the introduction of the Seshat dataset on *SocArXiv* [28,29].

In November 2019, the Seshat team uploaded another paper [30] to *SocArXiv* to test the other hypotheses related to the relationship between social complexity and moralizing religions, previously explored in the now-retracted *Nature* paper [15,16].

After that, the debate had supposedly died down. There are official publications on the *Journal of Cognitive Historiography* of the SocArXiv preprints. However, there was no concrete evidence to suggest that the debate will arrive at a final conclusion. Until 7 July 2020 (which was when this paper was under review), *Nature* published two articles concerning the retraction of “Complex societies precede moralizing gods throughout world history”: a Matter Arising article from Bret Beheim and his colleagues [31] and the retraction notice [16].

The Matter Arising article from Beheim et al. [31] is the peer-reviewed version of the first criticism [19] toward the moralizing gods paper. Meanwhile, the retraction notice, which was written by the Seshat team, concluded that there are issues with the data treatment. Even though there was still evidence for the original argument, the reanalysis suggested substantial differences that warranted retraction. The retraction notice also pointed to two other preprints that contain new analyses, and one was the preprint published in November 2019 [30], another preprint was published in April 2021 [32]. The April 2021 preprint suggested that the editors requested the retraction, and the manuscript itself is a serious effort in revising and fixing the mistake.

The chronology of this entire debate is summarized in Figure 1:

First of all, we need to talk about the role of data and statistical analysis in the current humanities literature. According to Whitehouse and Francois [23], data and statistics will help validate many long-standing theories in the humanities and push the boundaries of the disciplines. Data encryption and database construction can help to test historical theories, limit bias, and offer a unique perspective. In addition to the Seshat data, other studies have utilized ageless data sources such as folktales [33,34] and 20th-century house façades [35] to provide evidence for cultural phenomena. The open data movement and new guidelines such as the FAIR principles [36] are crucial for this trend to continue.

At the same time, datasets, collection methods, and data analysis are also widely deposited to Open Science Framework, Harvard Dataverse, Zenodo, and other repositories, allowing scientists to examine research results. Two critical reviews, respectively led by Bret Beheim and Edward Slingerland [19,20], are prime examples. They meticulously examined the process of data encryption and database construction to refute Seshat's research results.

To ensure the progress, they also took advantage of the preprint systems to bring their concerns to the public as quickly as possible. The rebuttal of the original research authors was also posted on the blog site for the prompt response. However, the dispersion of manuscripts on different systems was also confusing for readers. It is even possible to create the impression that the results of the unapproved preprint are accurate. Notably, the slow responses from the journals, which took one year (in the case of *Journal of Cognitive Historiography*) or two years (in the case of *Nature*) to provide official publications, did not contribute meaningfully to the debate [37].

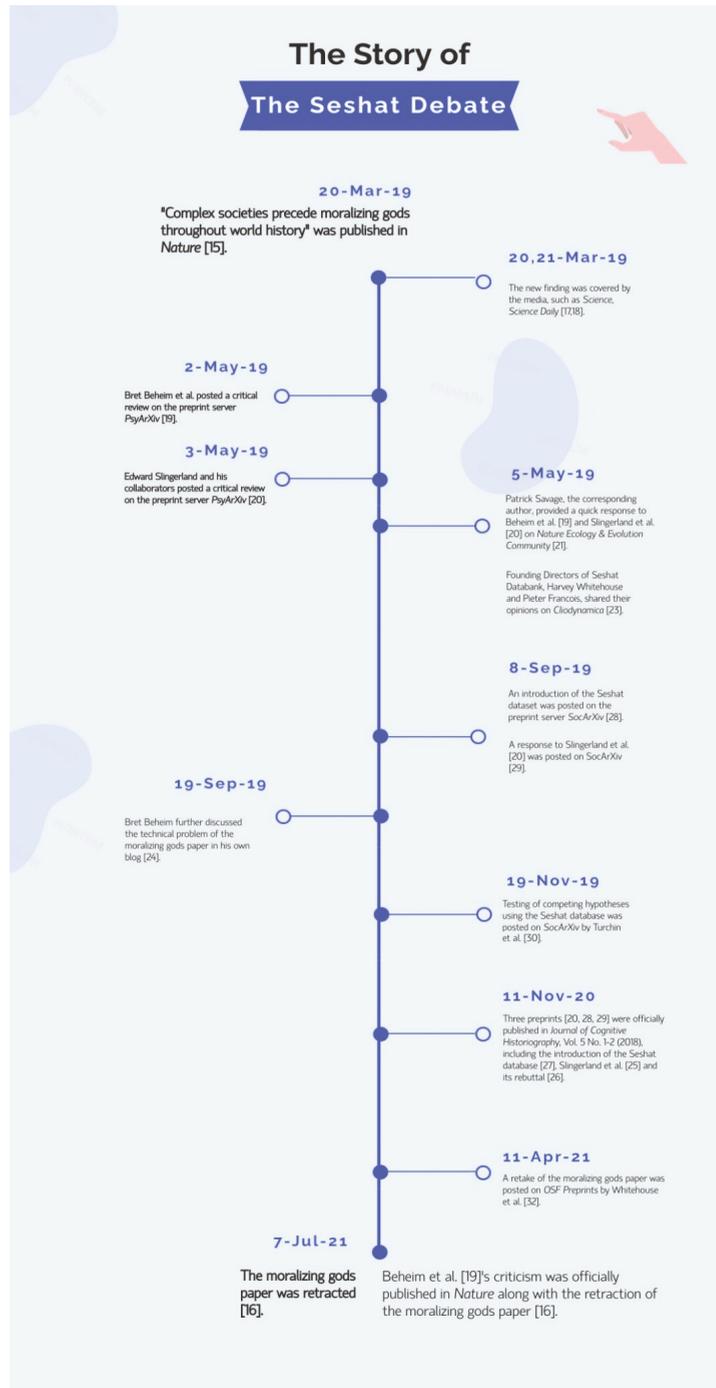


Figure 1. The chronology of the Seshat debate [15–21,23–30,32].

Besides the preprints system or blog sites, social networks like Twitter are also used to share formal critical articles, help researchers give some direct perspectives and directly address the subject of exchange. On Twitter, researcher Patrick Savage also made his point about this debate: a highly constructive dialogue representing the open science age [38]. Chris Kavanagh, a cognitive anthropologist at the University of Oxford, also appreciates the scientists' spirit of communication and frank criticism [39]. When posting on Twitter about the Seshat group's responses on *SocArXiv*, author Patrick Savage has directly tagged other scientists into his post. Many scientists even made their assessments on Twitter, such as researcher Richard McElreath's graph of moral deities based on Seshat data [40]. Furthermore, after two years without any update, Twitter allowed us to know about the retraction. Through tweets from Bret Beheim, Patrick Savage, and other scientists, the retraction notice was not buried under other pressing matters.

3. Total SciComm

Scientists involved in the Seshat debate have used a wide variety of media to communicate their concerns and responses. Preprints, social media, and blogs were used to spread the message across. Their flexible use of communication tools has provided a lively debate of scientific ideas and sensational findings. While the debate is largely internal, various aspects could be communicated to the public via different media.

In 1974, Netherlands went to the FIFA World Cup final and introduced Total Football (or *Totaalvoetbal*), a tactical system that has become the identity of Dutch football [41]. Total Football aims to exploit the football field's space through the fluidity of movements and the interchangeability of players' positions [42,43]. Its core philosophy has been inherited and continuously evolved by its disciples, such as Marcelo Bielsa or Pep Guardiola [41–44]. The attractiveness of Total Football lies in the combination of both aesthetic and effectiveness on the field. The style requires a deep understanding of positions and movements and perfection in basic techniques.

Inspired by the philosophy of Total Football, we would like to propose a strategy to do science communication called Total SciComm. Total SciComm uses every form of the media to communicate sound scientific ideas and engage all scientists in the process in its simplest form. However, just as Total Football demands perfection of the basics, Total SciComm demands a comprehensive understanding of the scientific process, total effectiveness in employing different media types to communicate science, and total honesty in science communication.

As open science has slowly become the new standard for modern science, the strategy is expected to provide total transparency in science communication. In return, the transparency to the public would help the communication be more efficient [45] and mitigate the potentially harmful effect of scientific retraction [46]. An early model of the Total SciComm strategy is presented in Figure 2:

Essentially, the Total SciComm strategy means using every medium to communicate science. In the Seshat debate, the conventional communication tools that are available were used effectively by the scientists. Traditional news media disseminated the main findings [17,18]. Preprints were used for rebuttal [19,20], while blogs were used for both rebuttal [21] as well as providing personal opinions [23]. Similarly, social media were used for quick public discussion.

These media were all included in Figure 2. However, we argue that there are other media that scientists should also utilize. The main goal is to bring science to a wide range of audiences, including scientists, policymakers, and the public. The differences in means of communication provide scientists with more ways to explain their ideas and results and reach audiences. For examples:

Scientific novel: human beings are a storytelling species, and storytelling is a powerful tool for scientists. Indeed, scientific research is often dry and technical, but significant findings can be translated into a narrative. For instance, Amanda C. Niehaus—a biologist—has written several novels and short stories based on her research. According to her own

experience, unlike the certainty of research, writing fiction lets her explore new possibilities and come up with new ideas [47]. Moreover, there are well-developed methodologies to translate scientific results into a visual novel format [10].

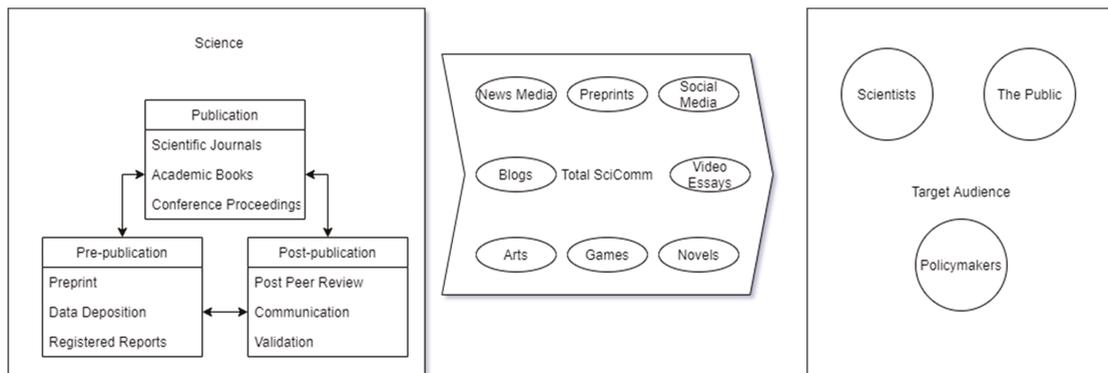


Figure 2. A preliminary model of the Total SciComm strategy.

Scientific film and video: on YouTube, crash course videos or lecture videos have received many views [48–51]. They are usually short but have a strong visual animation to support the explanation. As a more established art form, a film can suffer from the artistic expression of the filmmaker. Nonetheless, the ability to visualize a scientific concept is their strength. Classic science fiction such as *Blade Runner* (1982) [52] or *2001: A Space Odyssey* (1968) [53] utilizes scientific ideas and philosophical discussions. Nowadays, scientific journals have accepted video abstracts, providing another useful way to communicate the research.

Scientific game: the gaming market reached a value of US\$167.9 billion in 2020 [54]. The interactive gaming experience has become an important part of our popular culture. In the scientific community, scientists are testing board games or indie games to teach children scientific concepts [55]. Gamers even helped find a solution for the AIDS puzzle through a science puzzles game [56]. Recent studies also suggested the untapped power of using video games to raise pro-environmental awareness [57]. The scientific concept and gaming experience can also introduce the life and experiences of a scientist. The interactive nature of video games is especially useful in explaining various difficult and rigorous aspects of science: research design, concepts, inference standards, or methods. For instance, the Seshat database is a complicated data collection project that took several years to complete [27,28]. Scientists can understand the data collection process, but gamification of the data collection process might help the public understand science better.

Scientific art: artists have communicated abstract ideas for generations. However, artistic expression sometimes strays too far away from the scientific truth. It does not mean that art is unable to combine both artistic expressions and scientific ideas. From September 2018 to January 2019, Science Gallery London introduced an art exhibition exploring the concept of addiction [58]. Scientists and artists are searching for aesthetics, and there have been great artists who are scientists too.

While the idea sounds simple, its practicality can be challenging, especially with highly technical aspects such as methods. The challenge in using these media also lies in their high entry point. While writing a blog can be done easily, making a video requires scientists to possess various tools and skills. Essentially, while scientists are skillful in telling a scientific story in the traditional scientific publication format, adopting different formats is still uncommon, which is more of an add-on rather than a serious endeavor [11]. The difficulty in mastering different media formats might be some obstacles scientists must overcome. Yet, such uncharted territory offers not only unique strengths to communicate

different aspects of science but fertile grounds for scientific ideation, collaboration, and even business [59].

Moreover, when social media are magnifying misinformation and fake news, the usage of different media needs serious quality control. First and foremost, the Total SciComm strategy should be used on verified and peer-reviewed scientific results. The Total SciComm strategy will only work when the science is sound. This principle must not be compromised. Secondly, different forms of media have their own market functions. Thus, these functions should be utilized to become the second guard against misinformation, fake news, and other issues. For instance, films, video games, or arts have professional reviewers. In platforms with a social media nature like YouTube, the views, likes, dislikes, and the community itself are viable options for safeguarding quality.

4. Science Communication in the Open Science Era

In an age of open science, a peer-reviewed research paper could still face negative responses and criticism from colleagues. The academic exchange will no longer be under the veil of anonymity, but the scientists can now express their opinions freely through preprints or even social networks. In return, their opinions will also be publicly scrutinized. Thus, the need for effective science communication is more pressing than ever, especially during the COVID-19 pandemic [13]. MIT Physicist Max Tegmark has argued that the lack of active participation from the scientific community in communicating their ideas is dangerous for society's sustainability of society [60]. Moreover, lacking proper scientific communication, together with the lack of transparency, is a major reason why the public lacks a healthy perspective on the cost of doing science [61].

This paper proposes the Total SciComm strategy, which means the scientific community uses every medium to communicate science. While news articles, blogs, or preprints can reach the public in a conventional manner, films, video games, or arts can help embedded scientific ideas on a cultural level. Like how a football coach with the total football philosophy must adapt to the specific circumstances of each match and innovate to maximize the winning chance, the scientific community must also adapt and innovate their Total SciComm tactics to their circumstances. As new scientific ideas are always challenging, deep-rooted cultural factors can vastly influence how the general public adds these ideas to their worldview.

The paper has proposed a new metaphor to help shape strategic thinking in science communication: Total SciComm. Indeed, the scientific community has now increasingly engaged with the wider public utilizing more diverse communication tools and channels, yet, we believe there is a need for an umbrella term and a unique metaphor to capture the totality of the work of engaging the public with science. While we have presented the strategy with different examples, we acknowledge that there are still limitations [46]. First, this paper is not an empirical study. We rely on a specific case and various anecdotal evidence to propose the new strategy of science communication. Thus, there might be various aspects that need to be debated, tested, and falsified. Second, we used only one case to maintain the focus of our paper, which is to explain and discuss the core ideas of Total SciComm. Certainly, the Total SciComm strategy can be illustrated with different examples. Thus, we hope to address these issues in future research studies.

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