Bridging science communication and open science—Working inclusively toward the common good

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The 2020–2022 pandemic highlighted concerns about "information disorders", pressing for approaches capable of guiding the science-society alliance toward a mutually beneficial direction. This essay advocates for and presents a framework proposing the combination of Open Science (OS) and Science Communication (SciComm) practices. OS encourages public access to scientific material, while SciComm has historically enabled public understanding of scientific knowledge. Despite their similar goals, these two communities are disconnected. We draw on the concepts of "boundary object" and "epistemic trust" to demonstrate how this framework could foster a bond between scientific expertise and public reason toward an informed and inclusive common good. The OS-SciComm framework is based on the notion that ensuring transparency in science also requires "bridging tools" that deal with the complexity of scientific lexicon and processes. It values scientific expertise, but does not undermine citizens' capabilities in information processing and their interest in accessing scientific outputs. Our proposal also acknowledges controversies involving open scientific materials during the COVID-19 pandemic and advises caution when drawing conclusions from cases that are often context-specific. The OS-SciComm framework requires innovative ideas, platforms and actions. We invite both communities to join us in this endeavor.

KEYWORDS

open science, science communication, health communication, infodemic, epistemic inclusion, trust in science, public reason, pandemics

1 Introduction: the science-society connection

The COVID-19 pandemic is continuing to foster long-time lessons and expose areas not yet fully understood. One of them is the repercussions of an intense science-society connection that, at times, operated with no boundaries, almost as a contiguity (Allain, 2020; Fraser et al., 2021; Joubert et al., 2023). Another is the value of a strengthened collaboration between scientific research and citizens so that this alliance gets less "lost in translation" or

"half-stories"[1] and instead advances toward the common good. The 2020–2022 pandemic also highlighted issues about how information that involves scientific expertise circulates in society, and how science engages with societal demands and knowledge—concerns that are long-standing and not exclusive to this period (Beck, 1992). Given the complex interplay of various discourses in today's public sphere, it's urgent to test and establish frameworks that ensure a mutually beneficial direction for the intersections between science and society. The challenge is to do so while avoiding "broad-spectrum" solutions to problems that are often context-specific.

If controversies involving various forms of "information disorders" or "infodemics" (World Health Organization, 2021) should not be ignored, it's equally important not to underestimate citizens' abilities to effectively process information with condescending tones. History reminds us that elite assumptions about public capabilities have often marginalized certain groups from literacy, books, and politics. Science is no exception. Nevertheless, it's unrealistic to presume that the highly specialized language of science is universally understood. Centuries of boundary work (Gieryn, 1983) have constituted science as an autonomous field, with its own lexicon, methods, and particular ways of conceiving facts (Latour and Woolgar, 1979; Bourdieu, 2019).

Our proposal to address these concerns is to deepen the public's relationship with science—which was at times disrupted during the pandemic—through a framework that intertwines open science (OS) values and infrastructure with science communication (SciComm) values and practices. Broadly, OS refers to various practices designed to make different stages of scientific knowledge accessible to all (Nielsen, 2009; Foster and Deardorff, 2017; UNESCO, 2021), whereas SciComm has historically been seen as a means to enable public understanding of scientific knowledge and facilitate inclusion in science (Barata et al., 2018; Burns et al., 2003). This essay advocates for and presents an OS-SciComm framework. It seeks to foster ideas and actions that unite the two communities, based on the notion that ensuring transparency in science requires considering citizens' agency and that integrating different realities depends on bridging tools. In other words, we are dependent on boundary objects (Fox, 2011) that recognize the existence of borders, not to maintain them, but rather to seek ways to increase their permeability. In light of these possibilities, we will propose our framework through the discussion of the following questions:

a) How do OS and SciComm relate to the connection between science and society? Could a framework combining OS and SciComm serve as a boundary object?
b) How can the concerns with information flows that deepened during the pandemic be addressed in this proposal?
c) Does an OS-SciComm framework have the potential to lead science and society in a more mutually beneficial direction? If so, how?

2 OS-SciComm as a boundary object

Our proposed OS-SciComm framework is an attempt to materialize long-standing values related to making scientific knowledge available to the public. For decades, advocates of OS have argued that making research products and processes freely accessible benefits the public (Willinsky, 2005). Despite undeniable advancements (Piwowar et al., 2018), the well-intentioned argument has proven insufficient to guarantee universal access to knowledge—a limitation that OS scholars have recently addressed by providing a value compass for the movement that highlights inclusion (Leonelli, 2023). Recently, UNESCO (2021) (re)defined OS as an "inclusive construct", which should take into account the diverse forms of knowledge prevalent in society. These reactions arose, in part, from contradictions emerging when specific practices of OS, particularly open access (OA), were co-opted by business models. This shifted the costs of OA publishing to authors, placing a greater burden on developing countries (Demeter and Istratii, 2020; Zhang et al., 2022).

While OS scholars discuss the movement's contradictions and advancements over time, the debate for inclusion in science extends its community. The attempts to attract the public to science are historical, and almost as old as the scientific enterprise itself. These include an increase in books about science addressed to the public during the Victorian Era (Marshall, 2021) and the rise of popular public science conferences in Brazil during the 1800s (Carula, 2007). In the 1960s, the concept of scientific literacy emerged, promoting citizens' understanding of basic scientific facts (Bauer, 2017, 2009). This notion gained additional support in 1985, when the Royal Society published a document underscoring the public's need to understand both the achievements and limitations of science (The Royal Society, 1985). Most of these ventures, however, were predominantly aligned with hegemonic centers of science, often serving scientific interests.

Criticism about the benefits of these initiatives for citizens—and not just for science—sparked debates around diversifying SciComm models. These ranged from "deficit model", where citizens are seen as having knowledge gaps to be filled (Trench, 2008), to those considering public contexts and models that acknowledge audiences' specific knowledge (Brossard and Lewenstein, 2009). Recently, Davies (2022) proposed a shift in SciComm practices, from a focus on science's "impact" to revealing all processes in the scientific enterprise: an approach named as "radical openness", essentially what OS claims to be. However, despite this heated theoretical debate, resources for practicing SciComm overwhelmingly focus on making

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1 The expression alludes to "knowledge translation", a concept indicating both the communication of scientific findings to a broader audience in accessible language and the application of theoretical knowledge in practical settings (Brechman et al., 2009; Greenhalgh and Wieringa, 2011). The term "half-stories" suggests facets of the "misinformation issue"—information taken out of context, networks of falsehoods, and also various forms of misrepresentation registered in and about science, including exaggerated claims, hyperbolic language, inflation of therapeutic effects, and inappropriate causal inferences (West and Bergstrom, 2021; Southwell et al., 2022).

science "conceptually accessible" (Kelly and Autry, 2013) by reducing jargon, reframing findings to align with audience interests, and telling stories in addition to facts (Wynne, 2006; Simis et al., 2016). That is, SciComm efforts often focus on ensuring the public can understand scientific findings but rarely consider that they could benefit from accessing scientific data that underlies those results (Kelly and Autry, 2013). By doing so, SciComm risks perpetuating the deficit model by conceptualizing the public as too deficient to engage in science directly.

In sum, both OS and SciComm purport to advance access to scientific knowledge, yet often fail to do so in ways that are inclusive and empowering to a broader public. Moreover, despite clear overlaps in their goals, these two movements are often disconnected from one another. We propose a joint OS-SciComm infrastructure and practice to enable the contextualization and development of scientific culture—in the sense of stimulating engagement with scientific methods and epistemologies—while also not minimizing the public's potential to deepen their knowledge. We postulate and advocate that the OS-SciComm framework can be an enhanced boundary object that expands science borders, while also allowing for more permeability to societal issues.

To develop an OS-SciComm framework, SciComm content can begin by ensuring the basics: disclose the scientific article title and the journal, provide an open access link to it, and explicitly advise citizens to consult this material. Moving forward, innovative platforms can provide the collective construction of SciComm content based on the open material available. Scientific journals could expand the use of practices such as lay summaries, videos, and graphics. Innovations could go further with "docking stations", boundary-spanning spaces in which communicators and scientists can jointly foster science openness and its intelligibility. The initiatives above are just a small sample of how this alliance can work and we invite both the OS and SciComm communities to draw new ways to make this framework happen.

3 The pandemic case and fears about OS-SciComm infrastructure

We understand that during the pandemic the infrastructure of OS sparked concerns about the public risks of making research openly available. Problematic preprint papers, such as those involving hydroxychloroquine and articles that drew connections between COVID-19 and HIV, gained wide media attention before they were debunked, adding to rising levels of pandemic misinformation circulating in society (Brierley, 2021; Morin and Rof, 2023). Nevertheless, there's a need to better analyze the networks around these cases—that range from social media platforms to agents in polarized political contexts.

Specific concerns cannot hinder the effectiveness of open science during the pandemic (Boby et al., 2023), nor the opportunities it created for inclusion in science in some regions (Oliveira et al., 2023). Moreover, we should be wary of drawing broad extrapolations, which are not representative of the reliability

of preprints in general (Brierley et al., 2022) or of how journalists employ them (Oliveira et al., 2021; Fleerackers et al., 2024). Also, despite COVID-19 "infodemic controversies", a 2020 survey across 113 countries showed that trust in science actually increased during the pandemic in most regions (Wellcome Trust, 2020).

Hence, we urge caution when using COVID-19 examples to argue that scientific outputs should be withheld from the public. Such arguments also often assume that the public lacks the capacity, the need, or desire to access research—an assumption that is not evidence-based. Research suggests that when scientific articles are made openly available, as many as 16–35% readers engage with them for "personal interest" (Alperin, 2015). The public's interaction with scientific material is beyond the "information disorder" sphere: there is a search for vital life matters, and this is particularly pronounced among individuals with chronic illnesses and intricate treatment plans (Epstein, 1995; Oliveira, 2017).

4 Epistemic trust and the common good

Connecting SciComm and OS strengthens the science-society bond by also fostering informed epistemic trust. Epistemic trust is the fundamental way in which citizens relate to science and refers to the fact that, when dealing with certain dilemmas and issues, we necessarily have to delegate part of the investigation to professionals trained for this and trust in their ability to do so (Hendriks et al., 2015). There's a need, however, for this epistemic trust to be informed, since science can also be highly flawed and can put the public interest at risk (West and Bergstrom, 2021). Informed epistemic trust encourages vigilance over the limitations and potential of scientific knowledge—reflecting a paradigm that understands science as integrated into society and culture (Vogt, 2003, 2012; Bauer, 2012).

The OS-SciComm framework is a way to provide a basis for informed epistemic trust that moves toward the common good: it gradually shifts away from solely fostering the interests of science and also supports public reason in debating social dilemmas involving scientific expertise. The common good in a pluralistic culture is not defined by a specific stakeholder or as an *a priori* that everyone should aim for. Nevertheless, we could agree on the trivial principle that the good of the community could have precedence over specific interests, and take this as a moral action (Dupré, 1993). It's a framing for the Public Understanding of Science field that removes the subordination of the public from science, and points to a common goal achieved through deliberation and debates. This is not an immaterial reasoning. Historical instances of societal science participation (Epstein, 1995; Oliveira, 2017) and recent research involving citizen science (Damiani et al., 2021) suggest that, to engage with specific scientific fields, citizens must get closer to the language and processes of the scientific discipline they are trying to engage with. Additionally, with scientific knowledge getting closer to citizens, opportunities arise for a shift from "public understanding of science" to "science understanding of the public" (Rose, 2003)—in a way that does not merely involve simplifying

scientific jargon but rather positions society to claim its place in knowledge production.

5 Conclusion: the value of science expertise and public choice

Bridging OS with SciComm might be a first step to increase informed epistemic trust and encourage a dialogue between science and society that aims for the common good—as tough as it is to agree on a way to get there. A framework that brings together OS and SciComm values the expertise of science without undermining the necessity of enriching public discourse. Central to this framework is citizens' agency, echoing Brazil's historical education approach that sees the development of public "consciousness" as something that cannot be taught by others, nor achieved alone; people transform themselves, mediated by the world (Freire, 2018). The idea of an OS that turns to the world and joins the similarly oriented endeavors of SciComm, therefore, becomes a way to increase everyone's agency. It foregrounds that there is no common good without public debate and openness. We must be open in our methods and also flexible about the objectives we are trying to achieve. While it may be impossible to know beforehand what the common good will be, supporting science transparency and enhancing public choice is surely the way to get there.

Data availability statement

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Author contributions

MO: Conceptualization, Investigation, Writing – original draft, Writing – review & editing. GB: Conceptualization, Funding acquisition, Investigation, Writing – original draft, Writing – review & editing. AF: Conceptualization, Investigation, Writing – original draft, Writing – review & editing. JA: Conceptualization, Funding acquisition, Writing – original draft, Writing – review & editing. BF: Writing – original draft, Writing – review & editing. MB: Conceptualization, Writing – original draft, Writing – review & editing.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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