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Science communication during the COVID-19 pandemic: experiences, challenges and expectations from the perspective of scientists in Austria

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The COVID-19 pandemic put science in the spotlight like no other event before, but also created room for uncertainties, misinformation, and speculation. We used a qualitative research design and conducted semi-structured interviews with 13 scientists from various disciplines in Austria to shed light on their experiences and challenges with science communication during the pandemic as well as wishes and expectations for science communication in the future. The challenges most frequently mentioned by scientists refer to a lack of time to engage in science communication, uncertainty due to insufficient training in science communication, dealing with discrepancies between scientific advice and political decisions, and public skepticism towards science. Although almost all interviewees reported personal attacks via email and social media after public appearances, they emphasized the importance of transparency and openness in science to build trust and public understanding of scientific processes, despite such attacks. From the scientists' perspective future strategies should involve integrating science communication into university curricula and expanding scientific education in schools. Moreover, scientists ask for enhancing transparency in political decision making, explicitly distinguishing between scientific recommendations and political decisions. Scientists point out, that during the COVID-19 pandemic new transdisciplinary networks have been established, which have helped to improve and extend research collaboration past the pandemic and should therefore be maintained and developed in the future.

KEYWORDS

science communication, COVID-19, health communication, public health disaster, qualitative research, interview study

1 Introduction

The COVID-19 pandemic highlighted the importance and responsibility of science communication in informing the public as well as introducing and implementing health policy measures to contain the pandemic (Bromme, 2022). The novelty of this health crisis was accompanied by many uncertainties regarding transmission, symptoms, and long-term consequences (Fernandes, 2021). One special feature during the COVID-19 pandemic was the rapidly emerging global research from different disciplines. This research had huge

potential, but often overwhelmed decision-makers and society, making it challenging and overwhelming to identify reliable information. The large number of key figures and statistics that characterized communication about COVID-19 were often difficult to understand for people outside the field (Norheim et al., 2021). In addition to communication from scientists, political decision-makers and reports in the traditional media, COVID-19 was also discussed intensively on social media (Fenta et al., 2024). This situation not only left a lot of room for speculation and misinformation, but also made filtering the large amount of information in this "infodemic" a challenge for both scientists and the general public (Cheng and Nishikawa, 2022; Loss et al., 2021; Porat et al., 2020). Especially in the beginning of the pandemic the need for reliable and timely information was high. Scientists faced the challenge of communicating research findings in the midst of a constantly evolving situation while interacting with the general public and the media (Fernandes, 2021; Neresini et al., 2023; Porat et al., 2020).

2 Background

2.1 Science communication – definition and aims

Science communication encompasses "*the use of appropriate skills, media, activities, and dialogue to produce*" (Burns et al., 2003, p. 191) awareness, understanding, scientific literacy, and a culture of science within society. The aim of science communication is to encourage public interest in science, foster trust in scientific discourse, and inspire engagement with scientific topics (Burns et al., 2003). At a general level, literature suggests a broad consensus that science communication approaches can be categorized into two paradigms. One approach emphasizes the one-way transmission of scientific information from experts to the public, portraying communication as a process of knowledge transfer. The other approach, in contrast, prioritizes dialogue and deliberation, advocating for interactive engagement between scientists, lay-persons (often called "the public") and political decision-makers. The latter approach represents a more inclusive and participatory form of science communication (Bauer et al., 2007; Kappel and Holmen, 2019; Trench, 2008; Vickery et al., 2023). Both the National Academies of Sciences, Engineering, and Medicine (2017) and Kappel and Holmen (2019) outline key goals of science communication, with significant overlaps in their emphasis on public understanding, trust, and engagement. First, one of the main aims of science communication, in addition to sharing scientific information, is to increase public knowledge and appreciation of science to improve understanding of scientific principles and to promote critical thinking. Second, public engagement with scientific topics should be created. Here, participatory approaches such as citizen science are used. Third, strengthening trust in scientific institutions is another aim of science communication. Finally, science communication seeks to influence policy and societal decision making, both by promoting political support for science and by integrating diverse public perspectives into research and governance. In this study, we consider science communication as the diverse ways in which scientists shared their research and expertise with non-scientific audiences during the COVID-19 pandemic. We examine how scientists navigated different communication formats, perceived their role in public discourse and advising policymakers, and how they reflect upon their communication efforts in response to the circumstances of this public health crisis.

2.2 Science communication and public health

Goldstein et al. (2021) argue that *"science communication is a key link between generated science and public health impact"* (Goldstein et al., 2021, p. 989). Making complex scientific data understandable for diverse audiences is a key element of science communication. Clear and accessible language is a core principle of both science communication and public health messaging (Stewart, 2024). Successful public health interventions rely on community-wide support and compliance with scientific recommendations. Public trust in information providers is crucial for understanding of risks and adherence to public health measures (Safford et al., 2021). Scientific expertise can help shape effective public health policies and ensure that these policies are grounded in scientific evidence. Effective science communication is essential for building and maintaining that trust. Scientists who communicate clearly and transparently can enhance public adherence with health guidelines (Algan et al., 2021).

2.3 Science communication and COVID-19

The COVID-19 pandemic was unique, because political, social and scientific issues were all so closely intertwined (Bromme, 2022). A public health disaster like the COVID-19 pandemic is *"requiring explanations, urgent decisions, reassurance that the situation is under control, fore-sight about what will happen both in the short- and in the mid-term"* (Neresini et al., 2023, p. 5). The challenge for scientists was to communicate in a credible and action-orientated way in a crisis context, while at the same time being under pressure to disseminate information quickly. At a societal level science communication is very important during a public health disaster like the COVID-19 pandemic. It informs the public about the virus, its effects and the health risks it poses, helping them to make informed decisions. The complexity of scientific information necessitates clear and accessible communication strategies. Enhancing public comprehension encourages adherence to public health measures and guidelines (Berg et al., 2022). If people can comprehend why measures like lockdowns, school closures and more are necessary, they are more likely to change their behavior (Götz-Votteler and Hespers, 2021). Further, science communication helps to counteract the spread of misinformation (unintentionally false or misleading information) and disinformation (deliberately false or manipulative information) (Adams et al., 2023) on an individual and a societal level. At the individual level, misinformation and disinformation can reinforce false beliefs and promote attitudes and behaviors that are inconsistent with public health recommendations. On a societal level misinformation and disinformation can lead to polarization and hostility among different-minded groups within the society (Dan and Dixon, 2021). Both might have serious consequences for public health, which shows the importance of good science communication during public health disasters.

Rapidly changing information, as was the case with COVID-19, especially at the beginning, can lead to uncertainty and a subsequent loss of trust. It is therefore essential to communicate openly and transparently (Correia, 2024). A balancing act is necessary to openly show the limits of knowledge on the one hand, but still provide clear guidance on the other hand. This also means that scientists need to be honest about limitations of a study, what went wrong, where a lack of information is still present and where conflicts of interest could arise (Feufel, 2017). Due to the urgency at the beginning of the pandemic to learn as much as possible about the virus, many preliminary results were published and the number of preprints increased sharply. This bypassed the usual quality assurance provided by peer review. Therefore, transparent science communication also needs to point out the preliminary nature of results and explain possible flaws in studies (London and Kimmelman, 2020).

A lack of transparency or consistency in communication can quickly lead to skepticism in the public (Skotnes et al., 2021). Poor or unclear communication can lead to public concerns and subsequently to polarization and conflict (Porat et al., 2020). Particularly in times of a health crisis such as the COVID-19 pandemic, there is a great deal of uncertainty among large parts of the population. This creates a desire for clear statements and recommended actions. To build and maintain trust and understanding in public health measures in times of crisis, science communication should follow crisis communication theory and consider the following factors (Porat et al., 2020; Sopory et al., 2022): (a) Clarity and comprehensibility: Information must be easily accessible and understandable for all target groups, without excessive technical jargon. (b) Timeliness: Information should be disseminated quickly to inform the public promptly about current developments. (c) Accuracy and trustworthiness: Reliable and accurate information is essential to prevent misinformation and build trust. (d) Transparency: Openness about known facts, uncertainties and risks promotes credibility. (e) Consistency: Messages should be consistent across all channels and organizations to avoid contradictory information. (f) Engagement and inclusivity: Actively listening and engaging the public through different communication channels promotes trust and collaboration. (g) Multi-channel strategy: Information should be disseminated through different channels to reach a wide audience.

Science communication needs to strike a balance between pointing out the provisional nature of scientific results and ensuring that the public feels adequately informed and not unsettled (Loss et al., 2021). Public debates among scientists about uncertainties and different interpretations of results, as was often the case during the COVID-19 pandemic [i.e., resistance to the theory of airborne transmission (Greenhalgh et al., 2021) or differing recommendations for face mask usage (Feng et al., 2020)], can lead to uncertainty and confusion and reduce trust in science in general. An open and transparent explanation of the procedures and processes in research is necessary. Transparent exchanges between scientists, policymakers, journalists and the public include the communication and explanation of natural uncertainties and limitations in science. Such open exchanges help to promote the public understanding of the nature of science and build a long-term relationship of trust with science. For achieving such an honest dialogue, journalists play an essential role in explaining and contextualizing scientific findings and therefore shaping the public perception of science (Askvall et al., 2021; Bromme et al., 2022; Retzbach, 2020).

During public health disasters, political decision-makers often draw on scientific expertise to support them in developing measures and making policy decisions (Weible et al., 2020). For policymakers science communication is helpful to better understand scientific findings and use them to make evidence-based policy (Bultitude et al., 2012; Weible et al., 2020). Also during the COVID-19 pandemic, there was a public expectation for scientists to get involved in problem solving and offer political decision-makers their scientific expertise (Bromme et al., 2022). Although there is the expectation that scientists will give scientific advice in times of crisis, there is also the paradox that the authority of science is often called into question in crisis situations (Bijker et al., 2009).

2.4 The Austrian context

In their study examining skepticism towards science in Austria during and after the COVID-19 pandemic, Starkbaum et al. (2023) summarize the initial situation as follows: In Austria trust in science was high, particularly at the beginning of the pandemic. Virologists and epidemiologists were very visible in the Austrian media and shaped public debates as well as political decisions. The first lockdown came into force in March 2020, followed by further measures to contain the spread of the virus. As the pandemic progressed, public debates became more diverse, with economic and social issues gaining prominence. This shift also broadened the perception of science beyond a predominantly medical perspective. Political decision-makers had to consider not only epidemiological factors but also social, economic, and educational aspects, which often conflicted with one another—such as balancing school re-openings with efforts to control infection rates. This necessary balancing of different aspects and scientific recommendations from different disciplines complicated the political decision-making process (Starkbaum et al., 2023).

In Austria, several institutions were involved in providing scientific advice to political decision-makers. In the beginning of the pandemic, institutional involvement was unstructured, and the committee landscape lacked organization. Over time, structural changes led to a clearer organizational framework for mobilizing scientific expertise. The GECKO (Gesamtstaatliche COVID-Krisenkoordination = National COVID crisis coordination) became the main committee to collect and process knowledge about the pandemic and subsequently pass it on to policymakers in an understandable form. The meeting minutes were publicly available to create transparency and traceability. Overall, the developments in the committee landscape conveyed an image of efforts to improve scientific policy advice in Austria and to integrate it more effectively into the political decision-making process, but also highlighted the challenges of ensuring that scientific knowledge is effectively applied for political decisions (Bogner and Buntfuss, 2023).

2.5 Aim of the study

As described above, scientific evidence disseminated by scientists during a public health disaster plays an important role in communicating the potential impact and informing policymakers and the public. Science communication during the COVID-19 pandemic was particularly challenging for scientists. Although the importance

of science communication in times of crisis is widely recognized, little research has been done on the specific experiences and challenges of scientists in this context. Therefore, the aim of this study was to explore the scientists' perspectives on their own science communication during COVID-19. Specifically, our research questions were:

(1) What were the experiences of Austrian scientists involved in science communication during the COVID-19 pandemic? (2) What challenges did Austrian scientists face in science communication during the COVID-19 pandemic? (3) What are the wishes and recommendations of Austrian scientists for the future of science communication?

3 Materials and methods

To meet our research aim, we used a qualitative research design and conducted semi-structured interviews with 13 scientists from various disciplines in Austria. In selecting the interviewees, we aimed to obtain a balanced sample in terms of gender and scientific discipline. Reflecting the diverse expertise involved in COVID-19 science communication, the inclusion of participants from different disciplines provides a comprehensive picture of the challenges and strategies in navigating the complex interplay between scientific expertise, policy making, and public discourse during the pandemic. The distribution across disciplines in our sample is as follows: Medicine, $n = 5$ Public Health, $n = 2$; Computer Science, $n = 1$; Psychology, $n = 1$; Medical Data Science, $n = 1$; Political Science, $n = 1$; Economics, $n = 1$, Biology, $n = 1$. Six participants (46%) are female, seven (54%) are male, between 38 and 66 years old. They have been working in science on average 25 years with on average 18 years of experience with science communication. The scientists interviewed in this study worked in different sectors: one worked for a government agency, one for a research institute, and the rest were affiliated with universities or universities of applied sciences. They were selected based on their public visibility through media appearances and/or their roles in political advisory committees on COVID-19.

The study was approved by the Research Committee for Scientific and Ethical Questions (RCSEQ) of the UMIT TIROL – Private University for Health Sciences and Health Technology (number 3152). Potential interview partners received an email invitation to participate in our study. A total of 26 persons, recognized through media and public reporting on the pandemic, were contacted. Of these, six did not respond to the initial inquiry, four initially consented to participate but subsequently did not respond to follow-up reminders, three declined participation due to time constraints. Finally, 13 scientists confirmed their willingness to participate. Prior to the interviews, all participants were given verbal and written information about the aims of the research project, the voluntary nature of their participation in the interviews, and were assured of anonymity. Those willing to participate signed an informed consent form.

The interview guide covered four key topics: science communication in general, science communication and COVID-19, science communication and political processes, wishes for support and suggestions and ideas for science communication in the future. The first key topic dealt with the participants' general experience with science communication, as well as their motivation and reasons for engaging in science communication. In the second part, the questions focused on the impact of COVID-19 on science communication in general and their own science communication experiences in particular. Further the role of the media during the pandemic, the scientist's perception of the portrayal of science in the media and public trust in science were covered. Also, personal challenges during the pandemic, including possible threats, were included. The third part of the interview guide focused on the cooperation between science and politics during the COVID-19 pandemic. The final part covered the support that scientists received from their organizations for their engagement in science communication, their personal views on favorable conditions for high quality science communication and their expectations and wishes for the future direction of science communication. The complete interview guide is available as Supplementary material.

The interviews were conducted online using Zoom or MS Teams between January and April 2023 and lasted between 40 and 75 min. The interviews were recorded, transcribed and pseudonymized. The data were analyzed following the qualitative content analysis according to Kuckartz (2012) which aims to analyze textual material in a systematic and rule-based manner. MAXQDA24 software was used to support data organization and the coding process. After transcribing the interviews and initiating the text work, the authors developed a deductive coding schema with thematic main categories (Table 1), which were derived from the interview guide. The entire material was coded by two researchers. In the next step, subcategories, which complemented the deductive coding schema, were inductively formed for each main category and the material was coded again according to identified subcategories.

4 Results

The following section presents the key findings from the interviews, organized around the key topics of the interview guide and patterns that emerged during the content analysis.

4.1 Experiences

4.1.1 Pre-pandemic experiences of science communication

The first key topic of the interviews revolved around general experiences, attitudes and motivation for science communication in public health, outside of times of crisis. Almost all interviewees mentioned scientific articles and conference presentations as their major form of science communication. The majority of the interviewed scientists also used interviews with print media and TV, books or book chapters, and invited talks and lectures as communication channels. Science communication online was conducted by most of them, mainly via social media – especially on X / Twitter, Facebook, and LinkedIn as well as on the websites of their own research institution and on their own blogs. About a quarter of the respondents were also involved in participatory projects with schools and kindergartens.

In all cases, laypersons were named as the target group for science communication, and about a third also specifically named political decision-makers as recipients of their science communication efforts. Scientists with a medical background also mentioned doctors in

TABLE 1 Main categories, derived deductively from the interview guide (own elaboration).

Category title	Definition
General experience with Science Communication	Participants' overall experiences with science communication, including their level of engagement, motivations, perceived importance, and general reflections on their role as communicators.
Science Communication Challenges during COVID-19	Specific difficulties the participants faced when communicating science during the COVID-19 pandemic.
Threats & Hostilities faced	Experiences of participants facing personal attacks, threats, harassment, or hostility in the context of their public science communication during COVID-19.
Science Communication & Policy Making during COVID-19	Participants' experiences and perceptions regarding their involvement in political decision-making processes during the COVID-19 pandemic, including advisory roles, interactions with policymakers, and the perceived impact of their expertise.
Supporting needs	Participants' perspectives on what kind of support would improve their ability to communicate effectively, including institutional support, media training, or better engagement structures.
Wishes and recommendations for the future of Science Communication	Participants' recommendations on what would be important for effective science communication in the future, as well as their personal wishes for the role of science communication in the future.

hospitals and medical offices as one of their target groups. The interviewed scientists see their science communication as successful "when it is put into practice." Another indicator for successful science communication mentioned by most interviewees was when "interest in the topic is sparked and understanding is improved." The respondents inferred this, for example, from questions from the audience at events and from general interaction and feedback after media appearances. Responses were mixed regarding the nature of their science communication efforts, with about two-thirds of respondents indicating a tendency towards reactive engagement, e.g., responding to media inquiries or invitations to speak. Although they would like to be more proactive in their science communication, time constraints often prevent them from doing so.

4.1.2 Science communication experiences during COVID-19

The second key topic of the interview guide focused on the interviewee's science communication and their experiences with it during the COVID-19 pandemic. All interviewees agreed that uncertainty and speed of generation and dissemination of scientific findings were features of science communication that were particularly important during COVID-19. The urgency to find out more about the virus, its transmission, containment measures and treatment possibilities also changed the way in which scientific findings were disseminated. Several interviewees explained that the traditional peer-review process, as good practice for scientific publications, proved to be too slow for these fast-moving times. Therefore, the number of pre-prints increased significantly, which made quality control and the assessment of the trustworthiness of results more difficult.

Interviewees emphasized that a particular feature of communication during COVID-19 was what they perceived as excessive emotionalization and the spread of fear. One interviewee explained:

> "By the way, that's another difference between COVID-19 and the previous communication. In a crisis context, it also becomes overly emotional and filled with fear, so to speak. But in crisis communication, you actually want to communicate with confidence and emphasize the ability to act."

Due to the challenging circumstances, the importance of good and reliable science communication became especially apparent during the pandemic. Scientists, who were actively involved in science communication prior to the pandemic, reported that before the pandemic, they had often been looked down upon by colleagues and science communication activities had been ridiculed. This changed notably over the course of the pandemic and the importance of science communication became clearer:

> "Before, I mean, I've been working in the transfer sector for a very long time and it was always looked down on by many scientists if you deigned to talk to the public or politicians. This is no longer the case. People now see the importance of the whole thing."

Traditional mainstream media, such as television, radio and newspapers, were seen as an important vehicle for scientists' own science communication efforts and as essential for the rapid dissemination of scientific information and policy decisions to the public: "*The great potential is that you can also bring scientific topics more widely to the people. So, the media are basically an important factor in terms of the possibilities.*"

The participants actively engaged with social media platforms such as Facebook, LinkedIn, and Twitter (now X). These platforms were mainly used by the scientists to inform themselves about new scientific developments and findings as well as to network and exchange ideas within the scientific community. Most interviewees valued the speed and reach of social media in disseminating information or their own research findings. However, the exchange in the comments was often described as too time-consuming and the general public seemed uninterested in evidence-based discussion.

4.2 Pandemic communication challenges

In the following the challenges regarding science communication activities faced by the interviewed scientists are described.

4.2.1 Lack of time

The majority of interviewees reported that there is generally little time for science communication, even in non-crisis times. During the COVID-19 pandemic, the workload for many scientists increased considerably. In addition to intensive research into the virus, transmission, treatment, and prevention, as well as the social and economic impact of the prevention measures, they felt responsible and were asked to communicate their scientific findings to the public in an understandable way. This double burden—more research and increased science communication—often led to extended working hours and increased pressure on the scientists. One interviewee reported up to 15 media inquiries per day at peak times. The interviewees mentioned that this situation was experienced as mentally stressful and draining, and it was not only difficult for themselves, but it also conflicted with their personal obligations, such as family responsibilities.

4.2.2 Lacking science communication training

As science communication needs to be learned and systematically understood, some of the interviewees described the lack of science communication training as a challenge. One scientist said: *"But it's actually part of our job. It's a paradox that none of us has really been trained for it."* Scientists who felt insecure about their science communication skills also expressed uncertainty about how to adequately present scientific processes and results to the public. Moreover, they were uncertain about which communication channels are suitable for the dissemination of their findings. The balancing act between communicating in a way that is both, scientifically correct and understandable for laypersons, was described as difficult by many of the interviewees.

4.2.3 Limited understanding of scientific processes in the general public

The interviewees further described a limited public understanding of scientific processes as a major challenge. According to the interviewees, this challenge already existed before the pandemic: *"The problem is, to some extent, understanding what science is. Science is a discourse. Science is not one opinion and that is the right opinion. It is always a matter of questioning and knowledge also develops over time."* People outside the scientific community are often unaware that debating results and discarding theories as new evidence emerges is a common process in science, as one interviewee explained:

> "What was a bit difficult, or what seemed unfortunate, was that what we are used to as scientists, namely discussing data or what is part of our work and our communication, or even doubts about results or the way they were obtained, was brought out into the public. The impression that the scientific community is very divided has perhaps also created a bit of uncertainty among the population."

In the course of the pandemic, this uncertainty then developed into mistrust in science in parts of the population:

> "Yes, we don't have a very established science communication system per se. That's why we don't have that much credibility in the direction of science per se. And of course, that has carried through, and the stronger the polarization, the stronger the doubts towards science."

4.2.4 Role of media

The felt division of and polarization in society was mainly attributed to the way in which media reporting was carried out. One interviewed scientist described:

> "So, I really think that the media played a devastating role during the pandemic to some extent. A really, really devastating role. Yes, this extremely quick reaction with little factual background and alarmism, sensationalism, yes, I know that has to be the case. I realize that no one can help it, or almost no one. But it really is deleterious. And in a situation like this, it's simply dangerous."

By some of the interviewees this alarmist approach in the media was seen as a reason for news avoidance behavior among parts of the population, as the constant reporting of crises tired people out. One interviewee felt that the media coverage lacked a balanced, differentiated discourse, as it appeared for her more of swinging between the extremes of either a state of emergency or an all-clear. Moreover, interviewees felt that presentation of information in the media often was too abbreviated not offering enough context. Some interviewees criticized that media often insinuated a "false balance" by giving equal space to both sides of a debate. They suggested this equal media treatment of scientifically sound views and less well-supported opinions might have contributed to polarization and uncertainty, which impaired the effectiveness of science communication.

The quality and accuracy of reporting varied greatly among different media outlets. This led to scientists being selective about which media they worked with over the course of the pandemic. Some scientists regretted that due to budget constraints in most media houses there were only a small number of science journalists working at most media outlets. Keeping a clear distinction between scientific expertise and personal opinion, when giving interviews, was also emphasized as a challenging issue:

> "Journalists want answers very quickly to questions that you may not have dealt with at all. And to be prepared accordingly and to really think carefully in advance about how far I can go, what are my results, how can I communicate them, how can I communicate them clearly? But where can I draw the line now, where it might also be about my personal opinion?"

According to the interviewees, these boundaries between scientific expertise and personal opinion became increasingly blurred the longer the pandemic lasted. This was particularly true during periods when there was less new information about the virus. In some cases, the interviewees felt that they—as well as their colleagues whom they observed in media interviews—should have refrained from answering questions that were outside their field of expertise.

4.2.5 Threats and insults

Almost all the scientists interviewed (12 out of 13) reported threats and hostilities: *"All my colleagues have experienced an incredible amount of aggression. Up to threats against the family, so really massive things."* These threats took place both on social media, mostly Twitter (now X) and Facebook, and directly via email. Most

interviewees described the exchange with colleagues about the threats as a coping strategy. At the beginning, discourse was often sought, and the scientists still replied to such threatening messages. The longer such offences lasted, the more likely scientists decided to ignore and delete threatening and hostile messages. However, all of them emphasized that they would not have done less science communication as a result.

4.2.6 Political processes

In Austria, there were various expert committees set up by the government during the pandemic to advise political decision-makers on how to deal with the virus and the measures to be taken. It was first necessary to establish a mutual understanding between scientists and policymakers regarding their different working methods and time horizons. The views of the scientists interviewed were quite different regarding the translation of scientific recommendations in concrete political decision making and protective measures. Some of the interviewees felt not be taken seriously, when political decisions were made against their scientific recommendations. Others conceded that it is the task of politicians to weigh up decisions and to take into account different interests, influencing factors and effects. However, the interviewees agreed on the issue of transparency in decision making, *"[…] that politics should not use science as a fig leaf but should justify why decisions have been taken against science, against scientific advice."*

4.3 Wishes and expectations regarding science communication

Themes included in the last key topic of the interviews were: (a) the kind of support the scientists would like to receive regarding science communication from their institutions, (b) conditions that would ease their work in the field of science communication and (c) their wishes, expectations, and ideas for the future of science communication.

Requests for internal support within their own organization included media training, science communication training or support in dealing with media inquiries. Some interviewees also called for the creation of dedicated positions specializing purely in science communication. Differences were discernible here between disciplines: scientists with medical background or associated with medical universities felt already well supported, whereas researchers from other disciplines wanted more support from their institutions.

Several interviewees considered the integration of science communication into university study programs as a valuable opportunity to equip young researchers with science communication skills. However, as one interview participant mentioned, for this to be effective, the performance evaluation systems at universities would need to be adapted accordingly to adequately value science communication activities.

As emphasized by the interviewees, the ability to communicate complex scientific issues clearly and precisely is not only important for science itself, but also for society as a whole, as it contributes to informed decision making. Especially with regard to future (public health) crises, it would be important to anchor science in people's everyday lives, as another interviewee explained:

> "[…] we have some catching up to do in our country to regard science as something useful and important and not to see science as laboratory research on some mice, because that's not where it actually ends[…], but our everyday life is characterized by science, day in, day out, which means that much more educational work is definitely needed here, also in the future, in order to avoid that in any other crises, pandemics or similar, that people are then also heard and can better understand and comprehend any measures."

To facilitate this endeavor, some of the interviewees regarded the extension of sound scientific education in schools as a necessary foundation. An early introduction to scientific methods and critical thinking would prepare pupils to find their way in an increasingly technological and information-rich world. The interviewed scientists advocated for a solid scientific education at school. This would lay the foundation for lifelong learning and contribute to the development of informed citizens who can evaluate and apply scientific information. Overall, the respondents felt that they have gained experience during the pandemic that will enable them to create better and easier-to-understand science communication in the future. They also believe this experience will enable them to break down complex issues in a more comprehensible way. However, they saw a need to emphasize the importance and benefits of science for socio-political issues and decisions. One of the interviewees described the need to catch up: "*If science wants to assume social responsibility, then it also has to communicate, yes, otherwise science becomes detached from society and is then considered irrelevant by society, which, however, finances science.*"

The establishment of expert committees led to increased regular exchange between scientists and political decision-makers, which did not exist in this intensive form before the pandemic. The scientists considered these personal contacts and the mutual understanding of the respective working methods, to be very important for future collaboration and a good basis for evidence-based policy making. The interviewees noted that the collaboration in the advisory bodies for policymakers also led to strong interdisciplinary networking among the scientists. During the pandemic, networks and collaborations were established across disciplinary boundaries. According to the scientists, that would probably not have been the case without the pandemic. These collaborations have been continued and have already led to new research projects.

5 Discussion

The COVID-19 pandemic as a public health crisis was a phase in which science communication for scientists in Austria was associated with some challenges. Of the aims of science communication identified by Kappel and Holmen (2019) several had to be implemented at a time during the pandemic: in addition to creating an understanding of the disease itself and its consequences, another central aim was to promote public acceptance of health measures (e.g., vaccines and social distancing). To achieve these goals, it was necessary to generate trust in scientists and health institutions. And ultimately, science communication efforts were also about enhancing democratic legitimacy by including diverse scientific perspectives in decision-making.

Rapid developments, shifting scientific findings, and the demand from policymakers for actionable information put significant pressure

on scientists in their communication. Scheufele (2022) therefore sees a return to the familiar one-way communication approach, which sees science communication primarily as the transfer of scientific information. Our interviews reflect a similar pattern in communication efforts, which is understandable, given the urgency and complexity of the situation in the COVID-19 pandemic. Scheufele (2022) however, points out that a discourse on "*the interplay of information, societal structures, media ecologies, and social-psychological dynamics that explain how we all make sense of emerging science*" (Scheufele, 2022, p. 299) would have been important.

Interviewees mentioned lack of time, insufficient confidence and experience in communicating rapidly emerging findings to the public and policymakers, as well as hostility and threats following media appearances as biggest challenges. The role of the media was considered ambivalent: on the one hand, important for communicating scientific findings, but on the other hand, also seen as contributing to polarization of society. New interdisciplinary research networks were established during the pandemic, and according to the interviewees, they have continued to exist afterwards. For the future of science communication, the interviewed scientists envision more science communication training, better incentivization of science communication efforts and more scientific education in schools to improve public understanding of science.

5.1 Public understanding of scientific processes

The limited public understanding of scientific processes among the population was a frequently mentioned challenge in the interviews. Explaining the process of knowledge generation, scientific discourse and uncertainty proved to be difficult for the interviewees. Especially during a rapidly evolving crisis like COVID-19, it is important to acknowledge that scientific findings are preliminary. Scientists need to communicate that new evidence may lead to changes in recommendations, which is a normal part of the scientific process rather than a failure (Fernandes, 2021). In this context, the term "science literacy" is often mentioned in the literature. This term encompasses an understanding of scientific terminology, knowledge of scientific processes and the ability to assess the interactions between science, technology and society (Jarman and McClune, 2007). Science literacy plays a substantial role at both the micro and macro levels. Scientifically literate people are able to interpret scientific information and make decisions based on it. At the macro level, this means that a scientifically literate society tends to have a positive attitude towards science and is involved in democratic decision making on science-based issues (Rosenthal, 2020).

Some of the interviewed scientists described how the limited understanding of scientific processes developed into mistrust and increasing polarization in society over the course of the pandemic. The COVID-19 pandemic was a crisis that is referred to as an "*invisible hazard*" (Skotnes et al., 2021, p. 413) in risk and crisis management. Unlike visible threats such as extreme weather events or industrial accidents, the danger posed by the virus was not immediately perceptible to the human senses. As the threat is invisible, it is particularly important that the public has trust and faith in crisis management and the stakeholders involved, in this specific case political decision-makers who decided on measures as well as scientists and their scientific findings (Skotnes et al., 2021). To prevent mistrust, it is necessary to enhance public understanding and to be open and transparent. This should not be done in a top-down manner, but by entering into regular dialogue and exchange. Such an exchange between science and the public should take place regularly and not only in times of crisis (Helberger et al., 2022). However, the issue of trust cannot be addressed by scientists alone, as simply communicating trustworthy information alone does not create trust. Trust is established through an interplay at the individual, institutional and organizational levels. Journalists are here central actors in this interplay, who provide information and context and thus influence the public's trust in social institutions. They serve as "institutional mediators" (Flew, 2021).

5.2 Identified barriers for conducting science communication

Interviewees mentioned lack of time and uncertainties due to insufficient science communication skills and training as frequent barriers to regular science communication activities. Moreover, they criticized the lack of extrinsic incentives by universities to prioritize science communication due to a lack of consideration in career steps. These findings corroborate with earlier research by van Eck (2023), Bankston and McDowell (2018), and Lubchenco (2017) describing that in terms of career advancement, science communication and public outreach activities are usually given less weight than publications and grant funding. Science communication training opportunities are offered at some institutions, however not in a standardized way.

5.3 Role of media

The scientists interviewed described the role of the media as double-edged. On the one hand, they recognized the media's essential role for the dissemination of information. On the other hand, some of the interviewees had the impression that the reporting of many news media outlets was not neutral and balanced but tended towards alarmism and sensationalism. A similar result is shown by the study by de Sola (2021), in which scientists in Spain were asked about their perception of the COVID-19 media coverage: "*In total, three out of four experts think that sensationalism prevailed in journalistic information over other parameters*" (de Sola, 2021, p. 10). Neresini et al. (2023) also argued that balanced and reassuring science communication, as would be necessary during a public health crisis such as the COVID-19 pandemic, was often made more difficult by media that prefer alarming and sensational narratives. The scientists in our interview study expressed concern that such alarmism and constant confrontation with a topic can lead to a general resistance to media reports about COVID-19. This concern is confirmed by the study by Schäfer et al. (2023) in which 80% of the study participants stated that they actively avoided news about COVID-19, because it made them feel emotionally distressed.

The "false balance" in news media reporting perceived by the interviewees, where equal space is given to different findings, is partly due to the media's task of looking at a matter from different perspectives. But in the case of scientific results, where there is broad

consensus for a certain finding on the one hand and hardly any evidence for the other one on the other hand, this is misleading (Neresini et al., 2023). The decision of some interviewees after having made bad experiences to only work with certain news media outlets is understandable, but risky, because this means that certain population groups are no longer reached at all.

In science communication, journalists take on the role of "knowledge brokers," where they reformulate scientific content and organize it in such a way that scientific content can be made understandable to a broader target audience (Huber et al., 2019). In the age of social media, this role of the science journalist often ceases, as people find out about scientific findings directly on social media. Social media allow fast and direct communication about scientific research, but suffer from poor or lack of quality control and unfiltered information. The latter is conducive to the spread of misinformation and disinformation (Bucchi, 2017). Disinformation can lead to a polarized population with different opinions, during the COVID-19 pandemic regarding the measures, infections or vaccinations (Hart et al., 2020). The flood of mis- and disinformation during the pandemic has highlighted the importance of fact-checking public health information on social media (Xue et al., 2022). The spread of misinformation is likely to increase further due to the recent moves of X and Meta to abandon their fact checking programs (Riedlinger et al., 2025). The interviewees stated to primarily use social media to obtain information or to exchange ideas with colleagues, as they had the feeling that a real discourse and exchange with other user groups was not possible on these platforms. This is in line with the findings of Gosse et al. (2024) and Nölleke et al. (2023) which came to the conclusion that online environments, especially social media platforms, seem to foster insults and threats rather than discourse.

5.4 Cooperation with policymakers

The interviewed scientists described their collaboration with policymakers as important and generally effective, yet challenging in certain aspects. Scientists often find themselves navigating the complex landscape where public health recommendations must align with political realities. Some interview partners felt that as a scientist, they were often used as a fig leaf to justify political decisions. Therefore, the interview partners expressed the wish that political decision-makers communicate clearly and transparently how political decisions were made and draw a clear line between scientific recommendations and political measures. Particularly in high-stake situations, policymakers welcome the advice of scientists, in order to make governmental choices based on scientific evidence and thus legitimize them (Weible et al., 2020). This can create tension, as political leaders may prioritize different aspects, which can influence how scientific advice is received and implemented. While scientists could provide their assessments of the risk posed by the virus, how it is spreading and the impact of possible measures, the responsibility of weighing up various interests and making the final decision always stays the job of policymakers. However, it is important to communicate why which decision was made by the policymakers (Brusselaers et al., 2022; Norheim et al., 2021). Since such cooperation between science and politics in the COVID-19 pandemic occurred with such intensity for the first time in many countries, there were usually no clear descriptions of tasks or allocation of roles. For the future, it would be important to develop tasks and procedures (e.g., preparing weekly reports, scheduled briefings and feedback mechanisms) to protect the boundaries of the expert role and facilitate a trustworthy science advisory process (Colman et al., 2021).

5.5 Threats and hostilities

The threats and hostilities reported by 12 of the 13 interviewed scientists are not only a problem in Austria. In a quantitative study by Blümel (2024), 45% of the participating scientists in Germany stated that they had already experienced hostility by politically-motivated groups and individuals questioning or rejecting scientific findings. The study participants felt that hostility has increased in recent times. The international picture is similar: more than 60% of participants in a study by Nogrady (2021) reported negative experiences after talking about COVID-19 on (social) media. 22% received threats regarding physical or sexual violence and six scientists were attacked physically.

Such hostilities not only represent an emotional burden for those scientists directly affected, but can also influence the public discourse and the willingness to be involved in science communication (Blümel, 2024; Nogrady, 2021). However, the scientists in our interview study stated that they would not let hostility stop them from engaging in science communication. This finding is consistent with the results of Nölleke et al. (2023) exploring the willingness of scientists to attend further media appointments after they had been threatened.

Research institutions and universities are called upon to stand behind their employed scientists and to support and protect them. A zero-tolerance policy towards hostility and a commitment to protecting scientists can foster a more resilient academic environment, enabling better science communication (Gosse et al., 2024; Nölleke et al., 2023; Helberger et al., 2022). Because this is often difficult for individual institutions to achieve (Gosse et al., 2024), cross-organizational solutions are important. Initial projects in this direction include the SafeScience Initiative in the Netherlands (SafeScience, 2024), SciComm Support in the German speaking area (Bundesverband Hochschulkommunikation, 2024) and the project "Science Care," implemented by the Austrian Academy of Science (2022).

5.6 Wish for education and training in science communication

The interviewees frequently expressed the need for education and training in science communication. The lack of and need for science communication training is consistent with the results of previous studies: training for communication with lay people is rare and not standardized, and as a result many scientists are not trained for it (Altman et al., 2020; Bankston and McDowell, 2018; Brownell et al., 2013). Several of the interviewees suggested making science communication a standard part of scientific training in the future as a solution. The content of such trainings could include knowledge about the forms, channels and actors of science communication as well as which factors make science communication successful. Furthermore, a positive attitude towards the importance of science communication and self-confidence in one's own science

communication competences should be emphasized (Hendriks et al., 2022).

This is also recommended by the Helberger et al. (2022) as future scientists should not only be able to communicate more clearly, but also be able to enter into a dialogue with the public as well as political decision-makers. In this context, Bankston and McDowell argue that "due to the potential for science communication to produce better scientists, facilitate scientific progress, and influence decision making at multiple levels[…]" (Bankston and McDowell, 2018, p. 1) science communication training should be further expanded. Our interview participants reported increased exchange and interdisciplinary cooperation that developed during the pandemic. This favorable cultural shift towards more collaboration might also have an positive influence of the effectiveness of science communication (Helberger et al., 2022).

In their review of science communication during the COVID-19 pandemic in Austria, Starkbaum et al. (2022) concluded that an overarching and sustainable strategy for science communication in Austria is still lacking. Currently, science communication activities are often fragmented and not coordinated. A broad alliance involving universities, research institutions and funding organizations should be created to anchor science communication. Subsequently, accompanying research on science communication would also be necessary to evaluate the effectiveness and sustainability of the measures (Starkbaum et al., 2022).

The COVID-19 pandemic has highlighted the critical role of science communication in times of a health crisis. While numerous studies have examined public trust in science, media representations of scientific findings, and misinformation dynamics, less attention has been paid to how scientists themselves experienced and navigated these challenges. Our findings show that scientists not only faced a heightened demand for rapid communication but also had to navigate increasingly emotionalized public debates—often without adequate training or institutional support. This study contributes to science communication literature by providing an in-depth exploration of Austrian scientists' perspectives on science communication during the pandemic, addressing both structural and individual challenges.

6 Limitations

As with other interview studies, we cannot rule out the possibility of self-selection or recall bias. Furthermore, although we aimed for a diverse sample in terms of scientific background, the relatively small sample size limits generalizability. Admittedly, with 13 respondents we may not be able to fully capture the different perspectives within the broader scientific community in Austria. Nevertheless, we believe that our study provides insights into scientists' experiences, challenges and expectations regarding science communication during the COVID-19 pandemic. In doing so, it contributes to the literature on scientists' perspectives on science communication in times of crisis.

7 Conclusion

In conclusion, our semi-structured interview study reveals that scientists perceived the rapid generation and dissemination of scientific findings, alongside uncertainty and heightened emotionalization, as key features of science communication during the COVID-19 pandemic in Austria. This case study thus illustrates the central challenges and dynamics of science communication in a public health crisis.

Main challenges experienced by scientists were the general lack of time and training for science communication and the limited public understanding of scientific processes. The strong influential role of (social) media was also a challenge, as it favors the unbalanced dissemination of (mis)information, creates room for confusion and speculation, and contributes to mistrust and polarization in society. Further, scientists experienced threats and insults, which, however, did not affect their willingness to engage in science communication. Their experiences with political advisory roles varied, with some feeling disregarded while others acknowledged the complexities of political decision making as a compromise among competing interests. The scientists see interdisciplinary collaboration efforts initiated during the pandemic (e.g., through expert committees) as a chance for future collaboration. In terms of future directions, the scientists emphasized the need for support within their own organizations in dealing with (social) media, as well as the integration of science communication in study programs. Ultimately, based on experiences during the COVID-19 pandemic, Austrian scientists wish for a broader public understanding of science including its inherent uncertainties, transparent involvement of scientists in political decision making, and efforts to foster trust in science. The findings of this interview study highlight the need of fostering a science-literate society, improving support structures for scientists in public engagement, and establishing clearer communication pathways between science, policy making, and the media. Integrating science communication training in academic curricula, providing stronger institutional support for science communication activities, and ensuring more transparent involvement of scientists in political decision making can be seen as essential steps towards strengthening science communication. By identifying challenges and potential strategies for improving science communication, our study provides insights that are relevant not just for future health crises but for the broader integration of scientific expertise into public discourse and policy making.

Data availability statement

The datasets presented in this article are not readily available because the interview data is confidential and viewable only by the research team due to ethical requirements. Requests to access the datasets should be directed to nina.lorenzoni@umit-tirol.at.

Ethics statement

The study was approved by the Research Committee for Scientific and Ethical Questions (RCSEQ) of the UMIT TIROL – Private University for Health Sciences and Health Technology (number 3152). Potential interview partners received an email invitation to participate in our study. A total of 26 persons, recognized through media and

public reporting on the pandemic, were contacted. Of these, six did not respond to the initial inquiry, four initially consented to participate but subsequently did not respond to follow-up reminders, three declined participation due to time constraints. Finally, 13 scientists confirmed their willingness to participate. Prior to the interviews, all participants were given verbal and written information about the aims of the research project, the voluntary nature of their participation in the interviews, and were assured of anonymity. Those willing to participate signed an informed consent form.

Author contributions

NL: Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing. LH: Conceptualization, Funding acquisition, Methodology, Writing – review & editing. MF-T: Conceptualization, Funding acquisition, Methodology, Writing – review & editing. LF: Investigation, Writing – original draft, Writing – review & editing. CS: Conceptualization, Funding acquisition, Methodology, Writing – review & editing.

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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.

Generative AI statement

The authors declare that Gen AI was used in the creation of this manuscript. During the preparation of this work the principal author NL used ChatGPT 4o to improve writing style and check grammar and spelling. After using this tool, the author reviewed and edited the content as needed and takes full responsibility for the content of the publication.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcomm.2025.1519438/full#supplementary-material

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