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“It’s mostly a one-way street, to be honest”: the subjective relevance of public engagement in the science communication of professional university communicators

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Abstract

This study explores the subjective relevance and challenges of public engagement (PES) in science communication among professional university communicators based on 29 qualitative interviews in one German federal state. Despite recognizing its value, interviewees reveal significant uncertainties in understanding, objectives, and implementation of PES. They cite barriers such as reliance on scientists and control concerns. Surprisingly, social media is rarely considered for PES, with online engagement seen as difficult. This research highlights the complexities and challenges of PES in practice, emphasizing opportunities for optimized digital science communication strategies and clearer role structures between professionals and researchers to enhance PES.

Keywords

Digital science communication; Professionalism, professional development and teaching in science communication; Public understanding of science and technology

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1 ▪ Context

Not least in response to numerous global crises, there have been calls for greater public involvement in science communication [e.g., Scheufele et al., 2021]. The concept of public engagement with science (PES) signifies a shift in the relationship between science and the public, aiming to improve access to scientific information, democratize science, and foster public acceptance [Weingart et al., 2021]. Moreover, it is argued that public participation can enhance science quality through novel perspectives [Kouper, 2010; Miah, 2017], making PES a "gold standard" in science communication [Felt et al., 2017]. Political entities also increasingly require scientific organizations to conduct participatory formats regularly [BMBF, 2019; European Commission, 2013].

However, in the literature, PES is often vaguely defined [Calice et al., 2023; Weingart et al., 2021], encompassing diverse practices, motivations, actors, and objectives [Davies, 2013; Voß, 2019]. Here, PES is defined as science communication practices that enable participation, dialogue, and mutual learning [cf. Guenther et al., 2023]. While lacking clear goals [Riesch et al., 2016], PES is generally assumed to be inherently positive [Irwin, 2014; Stilgoe et al., 2014]. However, the debate often remains normative and uncritical [Jones, 2014; Stilgoe et al., 2014]. Although PES is increasingly central in science communication research [Losi, 2023] with new online opportunities emerging [Roedema et al., 2022; Taddicken & Krämer, 2021], the practical implementation of PES remains unclear. Hence, it is valuable to explore the perceptions of PES among relevant science communication actors.

Higher education institutions (HEIs) as "*the* core institutions" in the science system are increasingly important public science communicators [Volk et al., 2024, p. 2]. To meet rising demands for societal contribution and public responsibility, HEIs are expanding professional communicator positions [Fürst et al., 2022; Schwetje et al., 2020]. These professional university communicators (PUCs), working in either central communication departments or decentralized units of the university [Entradas, 2022; Volk et al., 2024], can serve as crucial intermediaries between science and society [Rödder, 2020].

Therefore, PUCs can play a critical role in shaping and operationalizing PES through their formats and activities, giving substance and context to what is often described as a "buzzword" [Weingart et al., 2021]. Their perceptions are particularly relevant, as clear regulations and formalization of science communication are often lacking [Metcalfe, 2022], allowing individual communicators significant scope in its implementation. Although research on PUCs' self-conceptions, professional contexts, and goals is expanding [e.g., Fischer & Schmid-Petri, 2023; Schwetje et al., 2020; Volk et al., 2023], empirical research on their deeper understanding and implementation of PES is lacking. Hence, this case study aims to examine individual perceptions of PES among PUCs in the German context through 29 semi-structured interviews, moving beyond normative debates to explore subjective relevance and practices.

2 ▪ Theoretical background

2.1 ▪ *PES in the literature*

Theoretical science communication models focus on the relationship between science and the public [Metcalfe, 2019], describing it as a continuum of increasing interactivity [Trench,

2008]. PES evolved from earlier efforts centered on the public understanding of science, grounded in a knowledge-deficit approach involving one-way communication strategies to address gaps in public knowledge about scientific issues [Bauer, 2009; Brossard & Lewenstein, 2010]. In contrast, PES is commonly perceived as involving two-way communication, encompassing dialogue between scientists and the public and active public participation [Brossard & Lewenstein, 2010].

In recent decades, science communication literature has increasingly advocated for such an interactive approach that actively engages the public [Davies et al., 2021]. This shift is widely celebrated as the "democratization" of science [Hu, 2024]. Even in politics, there is an increasing emphasis on making science more accessible to the public [Weingart et al., 2021]. Consequently, PES has become as a pivotal aspect of science communication, policy formulation, and decision-making [Koivumäki & Wilkinson, 2020].

The rise of digital communication environments has significantly expanded opportunities for PES, with online platforms facilitating interaction and enabling 'public online engagement' [Taddicken & Krämer, 2021]. In particular, social media has fundamentally transformed science communication practices by fostering active participation [Kupper et al., 2021]. However, it has also increased polarization, as science-related issues can be discussed more openly [Kupper et al., 2021; Neuberger et al., 2023]. Nonetheless, science communication actors, such as scientific organizations, can leverage these digital opportunities to engage broader audiences [Entradas et al., 2020].

Given its perceived potential, PES has become central in science communication research. However, it remains broadly defined, leading to fragmentation and diffusion of its meaning [Losi, 2023; Weingart et al., 2021], as it is understood as a "catch-all" term [Bensaude Vincent, 2014; Voß, 2019]. Therefore, it is difficult to speak of a single meaning of PES; instead, various terms, concepts, and categorizations exist [see Weingart et al., 2021, for an overview]. Scheufele et al. [2021], for example, suggest five PES modalities that reflect different goals: public communication, public consultation, public participation, public collaboration, and public empowerment. As outlined in this study, PES refers to *all communication about scientific topics directed at a non-scientific audience, enabling multidirectional dialogue and mutual learning between science and the public, both offline and online*.

While PES is widely advocated, some authors critique these demands, arguing they are often unreflective and lack common-good-oriented goals [Weingart & Joubert, 2019]. Little research has been conducted on the intersection between the growing demands for PES and how it is implemented by science communication actors [Metcalfe, 2019]. For example, there is little discussion on the specific objectives of PES [Besley & Downs, 2024]. Initial research indicates that many science communication practitioners prioritize knowledge dissemination over fostering dialogue [Nerghes et al., 2022; Yuan & Besley, 2021]. Moreover, digital communication environments necessitate a closer examination of science communication actors' perception of PES online.

2.2 ▪ *PUCs as relevant actors in science communication*

In recent years, scientific organizations and professional communicators have gained recognition for their pivotal role in science communication [Besley et al., 2021; Schäfer &

Fähnrich, 2020]. This acknowledgment has amplified the influence of communication efforts by HEIs within the field [Fürst et al., 2022; Marcinkowski et al., 2014; Volk et al., 2023]. HEIs differ from other organizations in their unique operational modes, which may lead to tensions in communication activities [Koivumäki & Wilkinson, 2022]. Communication departments within HEIs have to balance science communication with tasks like student marketing, public relations, and internal communication [Schwetje et al., 2020; Volk et al., 2023].

Amid growing demands for PES, HEIs face pressure to integrate PES into their communication practice, as policies increasingly mandate dialogue and public participation [Fürst et al., 2022; Weingart & Joubert, 2019]. Consequently, HEIs allocate more resources to develop science communication structures and expand the positions of PUCs [Fürst et al., 2022; Schwetje et al., 2020]. As PUCs play a key role in connecting science with society and contributing to public science communication [Entradas & Bauer, 2022; Koivumäki & Wilkinson, 2022], research on their role in science communication is growing [Fürst et al., 2022; Koivumäki et al., 2021; Volk et al., 2023].

While several studies have explored scientists' motives and perceptions of PES [Calice et al., 2023; Hendriks & Bromme, 2022; Kessler et al., 2022], research on PUCs' science communication practices, especially regarding PES, is limited [Volk et al., 2023]. Research indicates that PUCs are concerned with the societal impact of their science communication beyond strategic organizational objectives [Fürst et al., 2022; Koivumäki & Wilkinson, 2020]. This dual-faceted communicative orientation of PUCs is well-known from various qualitative and quantitative studies on their communicative self-conceptions [Fischer & Schmid-Petri, 2023; Schmid-Petri & Haimerl, 2022; Schwetje et al., 2020; Volk et al., 2023]. From recent research on this increasingly relevant professional group, it is known that navigating between the sometimes different expectations and system logics poses several challenges for individual actors [Fürst et al., 2022]. They state that they say sometimes lack the time and personnel resources to fulfill the various expectations [Schmid-Petri & Haimerl, 2022; Schwetje et al., 2020]. Furthermore, studies reveal that PUCs often encounter internal barriers as prerequisites for science communication activities [Autzen & Weitkamp, 2019; Koivumäki et al., 2021; Lo et al., 2019].

This could pose challenges for HEIs in the context of PES, as PUCs, in their intermediary role between science and the public, may play a crucial role in facilitating PES of HEIs. Studies indicate that PUCs can influence scientists' media efforts and science communication practices [Besley et al., 2021; Marcinkowski et al., 2014]. For instance, increased media requests by PUCs lead to higher compliance by scientists [Marcinkowski et al., 2014]. Institutional structures within universities shape the extent of scientists' PES, emphasizing the need to examine PUCs' perceptions of science communication [Bao et al., 2023]. Beyond supporting scientists, PUCs shape science communication themselves [Autzen & Weitkamp, 2019; Koivumäki et al., 2021], including activities of engaging the public [Borchelt & Nielsen, 2014; Koivumäki & Wilkinson, 2020; Volk et al., 2023]. Therefore, science communication is regarded as a pivotal function of PUCs [Entradas et al., 2024]. Studies indicate that they fulfill this role in terms of self-perception and from scientists' viewpoints [Fischer & Schmid-Petri, 2023; Koivumäki & Wilkinson, 2020; Marcinkowski & Kohring, 2014]. Therefore, PUCs can provide helpful insights into the practices of science communication and PES, including online activities [Koivumäki & Wilkinson, 2022]. However, ambiguities remain regarding their responsibilities and direct participation in communicating scientific topics [e.g., Besley et al., 2021; Koivumäki et al., 2021].

In addition, digital platforms offer new perspectives for PUCs' work, enabling them, for example, to assist scientists in performing their roles online [Koivumäki et al., 2021]. This requires continuous adaptation to a constantly changing environment [Roedema et al., 2022]. Although social media communication by scientific organizations is often said to constitute a major component of online science communication and shape public perceptions [e.g., Sörensen et al., 2023; Weingart, 2022], studies suggest PUCs rarely use social media [Belke & Marcinkowski, 2022; Entradas et al., 2020]. This highlights a gap in understanding PUCs' role in PES online.

While the existing literature primarily focuses on the self-perceptions of PUCs [e.g., Schwetje et al., 2020; Volk et al., 2023], their interactions and collaborations with scientists and other internal stakeholders [e.g., Koivumäki et al., 2021; Koivumäki & Wilkinson, 2020], the structural distribution of communicative roles within HEIs [e.g., Entradas et al., 2024], and content analyses of their online communication behavior [Volk et al., 2024], there is a research gap regarding PUCs' perceptions of PES.

3 ▪ The present study

In light of the increasing expectations to integrate PES into the science communication of HEIs, this study examines how PUCs understand, prioritize, and practice PES. We adopted an exploratory approach, focusing on PUCs' perceptions, as previous studies have shown that ideas, assumptions, and concepts about one's own professional roles and science communication significantly shape how work is performed [Kessler et al., 2022; Volk et al., 2023].

We carried out a case study in a large federal state in Germany because studying the perception of PUCs in Germany seems valuable, as it has been described as a "latecomer" in science communication [Weingart & Joubert, 2019, p. 3]. However, in all German federal states, stakeholders have recently begun to acknowledge and actively reinforce the importance of promoting science communication, which is often structurally embedded within dedicated departments of the state ministries [Scheu, 2024]. While science communication is gradually becoming recognized as a professional field in Germany, science communicators, including PUCs, often lack a unified understanding of their roles and objectives [Fischer & Schmid-Petri, 2023]. Moreover, most federal higher education legislation does not mandate science communication, meaning concrete guidelines are lacking [Roessler, 2024]. However, policymakers and research funders have increasingly advocated for dialogue-based communication [BMBF, 2019], with policy documents at both the federal and state level promoting participatory formats [#FactoryWisskomm, 2021].

Against the backdrop of these institutionalization processes in the context of PES in Germany [Weingart & Joubert, 2019] and with regard to potential tensions arising from differing expectations and interpretations of PES, we ask:

RQ1.1: What subjective understanding do PUCs have of science communication?

RQ1.2: What subjective relevance do PUCs ascribe to science communication in their own work?

RQ2: What subjective relevance do PUCs ascribe to PES formats in their own science communication?

RQ3: How do PUCs perceive their practices of PES in terms of formats, objectives, and barriers?

4 ▪ Methods

We conducted semi-structured interviews with 29 PUCs in Lower Saxony between April and July 2023. Lower Saxony is the fourth-largest federal state in Germany in terms of population [Statistisches Bundesamt, 2024b]. However, the gross domestic product (GDP) per employed person and the average income are slightly below the national average [Statistische Ämter des Bundes und der Länder, 2024a, 2024b]. While expenditures on research and development activities in higher education, measured as a percentage of GDP, are average compared to other federal states [Statistisches Bundesamt, 2024a], the number of students and of public universities is relatively high [Centrum für Hochschulentwicklung, n.d.; Statistisches Bundesamt, 2024c]. Lower Saxony's science communication landscape is primarily shaped by its public universities, complemented by non-university research organizations such as the Max Planck Society (6 sites), Fraunhofer Institutes (4 sites), the Leibniz Association, and the Helmholtz Association (3 sites) [Niedersächsisches Ministerium für Wissenschaft und Kultur, n.d.]. By focusing on one federal state, we explored the perception of PUCs performing their role in one specific context, as science, research, and education are primarily the responsibility of the federal states in Germany [Scheu, 2024]. In Lower Saxony, higher education laws do not explicitly outline science communication [Roessler, 2024]. However, a recent document analysis found efforts in policy documents to foster a 'cultural shift' towards dialogue [Scheu, 2024]. Moreover, the current goal agreement between the federal state and HEIs states that universities should endeavor to intensify dialogue and exchanges with actors outside of science [Niedersächsisches Ministerium für Wissenschaft und Kultur, 2024]. Therefore, this federal state seems particularly valuable when examining how individual PUCs navigate these demands.

Participants were deliberately selected [Etikan et al., 2016] to include at least one full-time PUC from each university in the federal state, PUCs from 10 of the 11 universities agreed to participate in the study. Eligible participants were those who worked at least 50% of their time as a PUC. The selection process included communicators from centralized and decentralized units, as well as individuals across various career levels and specific positions (Table 1).[1] The high proportion of women in our sample likely reflects the overall gender distribution within the field of PUCs in Germany, which is predominantly female, as indicated by larger survey studies [Schwetje et al., 2017].

Participants were recruited by contacting the heads of the central communication departments at all universities.[2] These heads then distributed the participation request to their employees and provided information about decentralized communicators at their respective universities. Identified decentralized communicators were subsequently contacted directly. Interviews were primarily conducted online, with some conducted in the interviewees' working environments. To obtain a comprehensive picture, we began conducting interviews at a large university (see Appendix A: Technology University 1) with centralized and decentralized units. We continued sampling at this university until data saturation was reached [Marshall, 1996]. At the same time, we also began conducting interviews at other universities. Since the same patterns emerged among the interviewed centralized and decentralized PUCs from different universities, we discontinued sampling once no new information was emerging from the interviews.

1. For an overview of interviewees per university see Supplementary material (Appendix A).
2. As one of the six full universities of the federal state did not respond to the multiple contact requests, no PUC from this university could be included.

Table 1. Sample of the PUCs interviewed ($N = 29$).

Sample description	n	%
Gender: Female	21	72.4
Gender: Male	8	27.6
Organization: University of Technology	11	37.9
Organization: Full University	13	44.8
Organization: Medical School*	5	17.2
Position: Management	10	34.5
Position: Staff	19	65.5
Type: Centralized	16	55.2
Type: Decentralized	13	44.8

* Here, 'medical school' refers to medical universities that are often affiliated with a larger university but operate independently in terms of funding, administration, and organization, and are formally considered independent organizations.

The interview guide was divided into two parts for a larger research project. The part relevant to this study focused on questions related to the understanding of science communication, subjective views on PES, the integration of PES formats, barriers to PES, and specific aspects of PES online (Appendix B). During the interviews, participants were provided with a definition of PES to ensure consistent understanding when discussing its implementation in their science communication. PES was described "as participation of the public with scientific topics or involvement of the public in science communication". Thus, for all results related to the research questions that explicitly address PES (RQ2 and RQ3), the definition was presented to the interviewees in advance, and the interviewees referred to this definition.

Interviews lasted, on average, one hour and 30 minutes (min = 00:58:57, max = 02:24:39). They were transcribed using f4x transcription software, followed by manual revision. The transcripts were analyzed in MAXQDA using thematic analysis [Braun & Clarke, 2006] in a deductive-inductive approach. First, deductive categories were derived from the overarching dimensions of the interview guide to create an initial codebook. This initial codebook was pretested with two coders (author1 and author2) on two interview transcripts. The coders discussed the coding line by line, adapting the coding instructions and adding anchor examples. The revised codebook was then independently applied to 30% of the material by both coders, ensuring a balanced representation of centralized and decentralized communicators and various positions. We achieved an intercoder agreement of at least 70% on the initial categories (test of code overlaps on segments in MAXQDA). Discrepancies were discussed, and the codebook was refined further (Appendix C). Deductively coded units were paraphrased to create inductive subcodes (Appendix D). Afterward, a single coder coded the entire material using the finalized category system (author1). The research team reviewed the overarching themes of the coded segments to build consensus. All quotations were translated into English for the presentation of results.

5 ▪ Results

5.1 ▪ *Understanding of science communication (RQ1.1)*

With our first research question, we aimed to get an impression of PUC's perspective and subjective relevance on science communication overall. This allowed us to indirectly deduce the role they ascribed to PES. Our cross-case analysis revealed different science communication understandings among interviewees. Some interviewees noted an increased importance of science communication overall: "It [science communication] has become a real buzzword. I think it refers to everything that communicates scientific work to the outside world" (I22, decentralized). Most interviewees perceived science communication as a *one-sided dissemination of scientific information and translation work from the science system to the public*, which aligns with the deficit model [cf. Trench, 2008]. Common statements included: "Science Communication is the presentation of research content and topics to a non-expert audience" (I23, decentralized). They primarily perceived science communication as explaining and disseminating science to a broad audience.

In contrast, few explicitly understood science communication as a *mutual exchange between society and science*, consistent with the dialogue model [cf. Trench, 2008]. These interviewees believed that science communication should not be limited to disseminating scientific content: "Ideally, it is not fired from the ivory tower, neither by scientists nor by me. It should be communication that is not one-way" (I17, decentralized). Another stated: "I understand science communication to mean informing and educating people about science and entering into a dialogue with people" (I14, centralized).

Moreover, interviewees often differentiated between science communication and organizational communication, such as student marketing. This indicates that many interviewees defined science communication as distinct from other communication activities. For instance, one interviewee stated:

> "I see processes like university politics or student marketing as separate from science communication. For me, science communication is about bringing the content of research to the general public and experimenting with new formats, always looking at what is currently relevant" (I25, centralized, head).

Another interviewee emphasized:

> "Science Communication, for me, is something that does not aim for a direct benefit in a financial sense or similar. Instead, it is primarily selfless communication aimed at embedding the presence of scientific thinking patterns, explanatory methods, and well-founded insights broadly within society" (I17, decentralized).

Following this point, one interviewee stated: "I think the public relations work is a bit more structured and strategic" (I19, centralized).

5.2 ▪ *Subjective relevance of science communication (RQ1.2)*

Interviewees' relevance of science communication in their daily work varied based on their unit and specific position. Our findings indicated that decentralized communicators, especially those within clusters of excellence,[3] tended to place higher importance compared to centralized communicators. For example, one decentralized communicator stated: "A very high priority: number one" (I17, decentralized), while another mentioned: "In fact, it permeates my entire work (I13, decentralized). These communicators frequently emphasized the significance of science communication, citing explicit job descriptions that outline it as their key responsibility: "It's the only job I have" (I6, decentralized). However, this does not necessarily imply they perform more science communication than centralized communicators.

The importance placed on science communication within centralized units varied with specific positions: "The tasks relating to science communication are distributed differently in the editorial team [...]. For example, I have a stronger connection to the individual faculties within the university" (I28, centralized). Due to their affiliation with university management, some centralized communicators felt that objectives aimed at serving the public good through science communication often competed with broader organizational goals. For instance, one head of a central communication department stated: "Unfortunately, I would actually say that university communication takes up more space because I report directly to the president" (I25, centralized). Overall, interviewees from centralized units often indicated a relatively low integration of science communication within their responsibilities: "Around 30 to 40 percent. So, a lot of it is actually just (...) internal [communication], or just in terms of media work, that I wouldn't necessarily see it as science communication" (I26, centralized). Several interviewees from both centralized and decentralized units expressed a desire for greater emphasis on science communication.

5.3 ▪ *Subjective relevance of PES (RQ2)*

Interviewees often considered PES — defined as participation of the public with scientific topics or involvement of the public in science communication — important. However, based on the subjective perceptions of the interviewees, PES did not typically occupy a central role in their daily practices. Notably, some interviewees indicated that science communication did not prominently figure in their daily work overall (*RQ1*), resulting in PES being perceived to play an even smaller or negligible role. For instance: "Engagement is not something that we have focused on so far, measured, or set as a goal. So, to be honest, it hasn't had any significance" (I6, decentralized). On the other hand, other interviewees expressed the goal of increasing PES, even though they have not yet implemented it: "So far, we haven't utilized it much, but it is certainly a goal we aspire to achieve, and we definitely want to pursue it" (I12, decentralized). In contrast, a few interviewees noted having established formats for involving the public.

Our analysis revealed differences between individual interviewees regarding the extent of PES in their daily work. One head of a central department even suggested that, in his opinion, science communication should never have been purely one-way:

3. Clusters of excellence are project-based initiatives that support internationally competitive research fields across disciplines within universities or university alliances. These clusters bring together researchers from various disciplines and institutions to collaborate on research projects.

> "It's just another new buzzword where I try not to do frontal communication. And I think that's always the crucial thing [...] It's something that, if you've done science communication well, you've been doing for decades. So, it's just a new label for me" (I10, centralized).

However, the majority of the interviewees stated that, despite growing expectations from policymakers and other stakeholders, PES formats constituted only a small proportion of their science communication activities: "Although it's mostly a one-way street, we do have event formats such as topic discussions and panel discussions that are open to interested members of society" (I21, decentralized). Some interviewees directly mentioned PES was of low importance because they did not see themselves as responsible for it. One head of a central communication department stated that, even if her communication office could theoretically be responsible, it was currently not the place for PES: "But I don't think we are the body that (...), or we could be, but at the moment we are not the body that creates the platform for society to get input from society" (I18, centralized, head). In addition, interviewees often emphasized that they could merely provide the infrastructure or platform. At the same time, they see scientists as primarily responsible for active interactions with the public (see RQ3).

5.4 ▪ *Perception of PES practices: formats (RQ3)*

The following results must be considered with the caveat that most interviewees did not consider PES central to their daily work. Many interviewees say PES primarily occurs during offline events (e.g., information days and dialogue events). They perceived the advantage of these events in their ability to facilitate direct experiences of science for target audiences. In their view, personal researcher-citizen interactions and direct contact with science can foster enthusiasm for science, making events that enable this particularly suitable: "Events, because it's really the personal contact" (I15, centralized). Some interviewees also highlighted formats with locations outside the university, as they enable low-threshold interactions: "So, it always works out well when we actually go out to places where we catch people, so to speak" (I4, centralized, head).

Surprisingly, only a few interviewees mentioned social media as a particularly suitable option for PES, with most rarely seeing it as an opportunity. Some viewed social media as a low-threshold option: "So social media formats definitely. There is a wide bandwidth of opportunities also for getting a discussion going" (I12, decentralized). While others saw the advantage of offline formats over online formats in the perceived greater proximity: "There you can respond more directly to each other and to what the other person says, so to speak. And through face-to-face communication, we are a bit closer than we are now on the internet. The access to the people is perhaps easier" (I2, centralized, head).

Considering the formats interviewees regularly implement in their science communication efforts, our findings indicate that most interviewees seem to perform formats spanning from events with limited interaction options (e.g., lecture series, panel discussions) to formats aimed at fostering exchange and discussion (e.g., science benches, science nights). Only a minority regularly conduct formats that facilitate direct public involvement in the research process (e.g., living labs, citizen science projects).

5.5 ▪ *Perception of PES practices: objectives (RQ3)*

When asked about their PES objectives, interviewees primarily mentioned *establishing a dialogue with society*, enabling them to better understand their audiences' interests and wishes. *Creating acceptance* was another crucial objective for many, who viewed PES as an opportunity to promote transparency and lower barriers to the university and science. As one head of a central communication department noted: "I find that exciting because it means science is definitely moving out of the ivory tower" (I7, centralized, head). Another interviewee similarly highlighted: "The barrier to the university is still relatively high. And we can simply lower it through certain event formats [...]" (I1, centralized, head). *Knowledge transfer* was also frequently cited as an objective. From the interviewees' perspective, PES can help citizens make informed decisions. Some identified *the acquisition of scientific knowledge* with the support of the public as a key objective, noting that certain research endeavors (e.g., bird counting) are feasible only through the active participation of citizens. An objective directly concerning scientists is the *opportunity for them to observe the impact of their work*, which, according to the interviewees, can be highly motivating:

> "For early-career researchers, conversations and interactions through PES serve as a significant motivational boost. Although it may seem clichéd, the doctoral student who previously had to explain to their parents why they still aren't earning money and what their research entails, [...] suddenly finds themselves interacting with a diverse audience — ordinary people, young and old, including retirees [...] These experiences are crucial as they help scientists find their place in society and stay grounded" (I1, centralized, head).

Other objectives mentioned by the interviewees were more aligned with the organizational level. Some interviewees stated that through PES they aimed to *recruit and retain young talents*, including pupils and university students. This encompassed breaking down gender stereotypes and promoting girls, especially in STEM subjects. Many interviewees spoke about *fostering reputation* through PES, believing it could attract attention to the organization and its research. For instance, one interviewee stated: "We use it to advance projects and to network with partners, to draw attention from policymakers" (I22, decentralized). Moreover, research results can be perceived and disseminated by multipliers. A few mentioned conducting PES *to fulfill the requirements of third parties*, such as a university administration or funding agency: "The German Research Foundation expects that patients will now also be involved, especially in the field of medicine" (I12, decentralized).

5.6 ▪ *Perception of PES practices: barriers (RQ3)*

The interviewees repeatedly mentioned a multitude of barriers in the implementation of PES formats. Many of these barriers are interdependent, making them difficult to distinguish clearly. In total, we identified six overarching barriers, described in detail below, along with more challenges specifically related to social media.

A significant barrier often stemmed from a *reliance on scientists*, perceived at various levels. Some interviewees stressed a dependence on scientific findings to carry out PES: "No matter

how important I consider my work to be, without scientific knowledge, the other aspects remain challenging" (I1, centralized, head). Many considered scientists to be primarily responsible for PES, indicating a delegation of responsibility for PES to scientists. As one head of a central communication department stated: "Yes, we are actually completely reliant on certain people to get involved because we can do a lot ourselves, but of course, that's not what we want to do and shouldn't do. In other words, I always need scientists to support our formats" (I4, centralized, head). One interviewee said: "But at the end of the day, it has to be done by the scientists" (I21, decentralized). However, they acknowledged that scientists often face heavy workloads, leading them to deprioritize PES. Furthermore, inadequate communication skills among scientists were seen as a barrier, as not all scientists were deemed suitable for PES.

Moreover, many interviewees mentioned that a crucial barrier is the public's *lack of awareness and acceptance* of PES formats, contrasting with their high perceived costs. Interviewees often stated that the public does not utilize the engagement opportunities offered: "It also happens that I think a topic is truly engaging, put a lot of effort into it, release it expecting a significant response, and receive none. Then I reflect on whether I made a mistake and attempt to identify the underlying issue" (I17, decentralized). According to the PUCs, the *lack of acceptance and awareness* of PES formats is particularly prevalent among hard-to-reach target groups, such as educationally disadvantaged citizens. This challenge aligns with the general difficulties of reaching them through science communication formats.

Furthermore, some interviewees perceived a *lack of resources* for PES formats. They emphasized constraints such as limited financial and time resources required for successful PES. They noted that PES formats often demanded significant efforts: "That you have to prepare it well so that it is really effective and that you don't say after two hours, 'Oh God, I could have done without that because nothing came of it'" (I13, decentralized).

Another perceived barrier was *topic constraints*. Certain research topics were deemed less approachable or suitable for PES. This barrier was mainly expressed by decentralized communicators responsible for a specific research project, which they felt was impractical for PES. One interviewee noted: "So I don't know, engagement can be done if it fits the topic somehow" (I5, decentralized). Some interviewees expressed reservations about basic research, fearing PES formats in this context would overwhelm the public and hinder follow-up communication due to its distance from everyday life.

In addition, a few interviewees expressed *concerns about false public expectations*. They feared that once laypeople are engaged in science communication, it might raise expectations of continuous involvement. In their view, this ongoing involvement is often not feasible given scientists' primary focus on scientific research. The following quote reflects this aspect:

> "If we speak quite frankly when we open up to certain groups here, there is always the expectation that scientists have a certain role. They are, first and foremost, scientists who conduct research. Then, there is the expectation that there will be continuity. Well, we simply can't provide that" (I22, decentralized).

Many interviewees feared that PES offers a low-threshold opportunity for *voicing criticism or even hostility* online and offline. They were concerned that participative formats could result

in negative feedback, potentially causing reputational damage to the organization. This concern existed above all for the online context, especially when communicating polarizing topics. One interviewee noted:

> "It is very topic-specific. So, the topic of animal testing is a difficult one. It's a difficult field to communicate in any case, and even more so on social media, which thrives on rapid interactions and is often used by various organizations to disseminate their content and opinion" (I27, centralized, head).

A few interviewees stated that they even deactivated interaction options on social media due to these concerns and resource constraints for moderation: "In some places, we deliberately deactivate it [comment function] because we find it difficult to manage the moderation of the 700 or 800 videos" (I1, centralized, head).

From the interviewees' perspective, not only do criticism and concerns about hostility pose barriers to PES online, but they highlighted more challenges specific to social media.[4] These challenges may explain why many interviewees did not consider social media as a suitable PES format. It is important to note that almost all interviewees utilize social media, at least indirectly, for (science) communication. However, the extent of this usage varies. Some interviewees are primarily responsible for social media communication, while others only prepare content or even lack direct experience. Regarding challenges related to social media for PES, we focus only on the barriers mentioned by interviewees with direct experience, including the heads of central communication departments, as they are responsible for the social media strategy of their departments.

One perceived challenge was the *high level of competition online*. The following quote illustrates this:

> "However, even then, I believe, online there is always the huge challenge that one competes, of course, with a multitude of offerings and, above all, with established offerings, for example, in the field of science communication, there are of course also online offerings from public broadcasters, I can think of various offerings from Funk [Youth channel of the German public broadcasters] and they naturally have completely different reach than if I communicate" (I28, centralized).

Another mentioned barrier was the *lack of control* over social media, with concerns raised about unpredictable algorithms online and the overall management of communication. One interviewee stated: "So you can also say, 'We absolutely have to post a viral video at some point.' But whether something goes viral or not, you can't really choose" (I17, decentralized). Another interviewee highlighted: "Also, you can't really control that. Ultimately, you can rarely control if mischief is somehow made or if comments are posted below where you then have to consider, 'Should we respond to that, should we delete it?'" (I24, decentralized). The fear

4. This must be considered in light of the fact that the guidelines included explicit questions on experiences of PES online.

of losing control went hand in hand with the concern of *a faster loss of reputation* on social media: "This can lead to quicker reputational damage, amplified by the broader reach that ensures wider dissemination and greater difficulty in mitigation once escalation occurs" (I2, decentralized). Furthermore, many interviewees perceived a *lack of interest among users in scientific topics on social media*, which they explained with relatively low engagement rates. One interviewee argued: "So we also address research topics, but the response to them is simply extremely low" (I28, centralized). In the view of many interviewees, social media is more suitable for student marketing or organizational communication, which they distinguished from science communication. However, most interviewees did not reflect on new PES approaches for their social media communication. Only a few mentioned a need for optimization in their digital science communication strategy. One interviewee stated:

> "Social media formats for science communication are not well received by us. They aren't liked much; they aren't commented on much. That's because not so many people are interested. But it could also be due to our format, which is a bit outdated" (I26, centralized).

6 ▪ Discussion

The findings of our case study reveal differences in the understanding of science communication and the value of PES among our interviewed PUCs, depending on their specific positions and organizational affiliations, aligning with previous research [Entradas et al., 2024; Entradas & Bauer, 2022]. Many interviewees sought to distinguish science communication from more strategically oriented university communication, highlighting the already known dual role of PUCs: acting as mediators between science and society for the public good, while also aligning with organizational goals [Lo et al., 2019; Volk et al., 2023]. This distinction is complicated by a perceived blurring between societal and organizational goals, as illustrated by the mentioned organizational objectives of PES, suggesting that these goals should be viewed as a continuum rather than in tension, as has already been proposed [Entradas & Bauer, 2022; Fürst et al., 2022].

Moreover, consistent with previous research [Volk et al., 2023], we found that PUCs tend to understand science communication as primarily unidirectional rather than multidirectional. This aligns with the perspectives of scientists [Calice et al., 2023], indicating a common knowledge-deficit mindset among science communication actors within HEIs. However, not all interviewees viewed science communication as one-way; some referenced dialogue conceptualizations. Many recognized the increasing importance of PES, including for organizational legitimation, despite noting complexities in its implementation. Nevertheless, most interviewees rarely conduct PES formats regularly. Our results suggest that although interactive science communication approaches are increasingly advocated, as also found by Davies et al. [2021], they do not yet appear to have been implemented in practice. Particularly in the context of our case, our findings show discrepancies between the growing demands for PES [e.g., Niedersächsisches Ministerium für Wissenschaft und Kultur, 2024] and its implementation. Hence, our findings indicate a disconnect between the "buzzword" in policy documents and science communication research [Weingart et al., 2021] and its actual integration into everyday practice.

The interviewees mentioned objectives, such as *knowledge transfer* and *recruiting and retaining young talents*, which are rather broad. They did not differentiate between various modalities of PES, each of which can be associated with different objectives [Scheufele et al., 2021]. Thus, our findings reflect the lack of clarity about what should be achieved through PES [Riesch et al., 2016]. Since our qualitative approach encouraged interviewees to express their views in detail without preconditioned specifications, we were able to uncover various uncertainties in both the understanding and implementation of PES. The identified uncertainties in our case study are consistent with the ambiguous use of the term in scholarship [Weingart et al., 2021] and among scientists [Calice et al., 2023].

The findings of our case study underscore the necessity for closer collaboration between scientists and PUCs in science communication, particularly in PES activities [Autzen & Weitkamp, 2019; Koivumäki et al., 2021]. The interviewees' perception that scientists are primarily responsible for PES aligns with previous studies [Lo et al., 2019]. This highlights the requirement for well-defined roles and responsibilities between PUCs and scientists, considering the autonomy scientists often exhibit [Koivumäki & Wilkinson, 2022]. Potentially divergent goals and intentions in communication between scientists and PUCs [Koivumäki et al., 2021] underline the significance of comparative analyses in this context. Mutual learning between PUCs and scientists about each other's expertise could prevent misunderstandings and improve collaboration in PES efforts.

The mentioned low engagement rates on social media by the PUCs align with quantitative studies showing relatively low levels of interactions with universities' social media channels [Volk et al., 2024]. Moreover, our results indicate that PUCs seem to fear a lack of control and aggressive forms of public participation, especially on social media [cf. Zimmerman et al., 2024]. Due to a responsibility for their HEI's reputation, PUCs seem to be particularly concerned about negative repercussions online. Furthermore, they do not always feel equipped to participate in online discussions about scientific issues. It remains unclear to what extent the perceived lack of user engagement with scientific topics online might also depend on the provided formats. The low utilization of social media for PES presents opportunities for optimization, pointing to the potential benefits of targeted training on integrating new digital tools and strategies, such as moderating online discussions.

Our qualitative approach enabled us to identify various perceived barriers in the context of PES that may hinder the regular implementation of PES formats. These barriers, such as reaching target groups or concern about reputational risks, do not appear to be specific to the case of our federal state, but represent challenges that can also be expected in other contexts. They highlight pressures anchored in organizational structures within the role of PUCs as communicators officially responsible for the external reputation of their HEIs [Volk et al., 2024], which influence their everyday actions. A recent German study has shown that PUCs often prioritize communication formats with easily measurable success, particularly when resources are scarce [Banse et al., 2024]. This often serves to legitimize their communication work, which is scrutinized for its return on investment by academics or management [Banse et al., 2024]. In contrast, formats deemed suitable for PES by the interviewees, like offline events, require significant resources and might be seen as infeasible due to the outlined barriers, such as the public's lack of awareness of PES formats. To implement participatory science communication formats regularly, our case study suggests that organizational structures for PES in HEIs must be created to more effectively integrate PES into overarching strategies. It seems essential to establish a shared understanding of

objectives of PES among all internal and external stakeholders. Additionally, training and workshops on the effective integration of PES into science communication in HEIs could help reduce perceived barriers. This also involves activities to identify the audiences' expectations toward science communication formats of HEIs [Wicke & Taddicken, 2020].

7 · Conclusion and outlook

Against the backdrop of rising expectations to foster PES, this case study examined how PUCs perceive and implement PES within their science communication, offering insights into the value, formats, objectives, and barriers in this context. We identified various uncertainties in implementing PES, particularly concerning social media. Addressing the perceived barriers and clearly understanding what should be achieved through PES is crucial to fostering effective PES in HEIs. We acknowledge that traditional dissemination activities are not necessarily inferior, and PES is not automatically positive. Rather, we aimed to understand how PUCs conceptualize and implement PES to gain insights into its practice.

Several limitations should be considered when interpreting the results: Our study is based on a sample of 29 PUCs from only one federal state in Germany, which limits the generalizability of the findings. However, our case study provides an in-depth understanding of the perceptions of PES and its implementations within a specific context, where expectations for PES are growing. Moreover, the barriers identified in this case study — such as unclear role understandings between researchers and PUCs, fear of reputational loss, and challenges associated with PES — are largely structural and organizational. These challenges do not appear to be unique to the federal state examined here. Instead, similar patterns have been observed in previous studies addressing PUCs' general communication practices and role conceptions, both within Germany and in other Western countries [e.g., Fürst et al., 2022; Koivumäki & Wilkinson, 2020; Schwetje et al., 2020; Volk et al., 2023]. While the qualitative nature of this case study does not allow for generalizations, the structural characteristics of the barriers indicate broader trends in PES and science communication within HEIs, particularly in regions where similar institutional and organizational frameworks shape science communication practices. By focusing on communication units, we did not include other institutions outside the HEIs that possibly implement participatory activities, particularly at the larger university locations. Moreover, concentrating on subjective perceptions instead of actual implementation practices limits the ability to draw conclusions about real-world applications and the extent to which the perceived barriers truly exist.

Nonetheless, the study opens multiple avenues for further research. Document analyses on HEIs' level might provide insights into the underlying conceptions of PES on meso-level [cf. Sörensen et al., 2024]. Through our qualitative approach, we were able to identify perceived barriers that may explain the low implementation of PES in science communication, despite its acknowledged importance, as demonstrated in our case. These insights, drawn from our specific case, can serve as a starting point to explore the extent to which the identified patterns are also evident in other contexts. Future research should explore the underlying mechanisms and processes contributing to the differences in understanding and valuing PES among PUCs. Conducting content analyses of actual science communication outputs can provide a more comprehensive understanding of PES practices by considering subjective perceptions and the actual implementation. In addition, investigating more closely how scientists perceive their role in PES compared to PUCs could provide deeper insights into

the dynamics of science communication at HEIs. Furthermore, understanding the public's desire to participate in science communication activities is essential for designing effective strategies, as citizens are often overlooked despite their centrality in PES [Hu, 2024; Losi, 2024].

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Supplementary material

Available at https://doi.org/10.22323/2.24010203
Appendix A: Overview interviewees per university (N = 29)
Appendix B: Question complexes of the interview guide that relate to public engagement
Appendix C: Category system for the coding of interviews
Appendix D: Category system with the identified subcategories

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