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Between Open Deliberation and the Capturing of Public Opinion: Producing Opinions in Public Engagement

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Abstract

The past decades have seen increasing calls to actively involve publics in the governance of science and technology. Many public engagement initiatives aim to facilitate the formation of public opinion. But what is an opinion? While the notion is often taken as self-evident, different imaginaries of what opinions are and how they should be formed are highly consequential for shaping relations between technoscience and society. Based on participant observations and interviews, we analyze how "opinion" is enacted as an emergent object and category with specific properties and uses in a series of public engagement events on genome editing. By identifying two

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prevalent goals tied to partially conflicting imaginaries of opinion—open deliberation and "capturing" public opinion—our analysis contributes to a more reflective understanding of the tensions that participation facilitators navigate when making opinions their central points of intervention in the coevolving relationship between technologies and their publics.

Keywords
engagement, intervention, public participation, opinion, gene-editing, political epistemology

Introduction

The past decades have seen continuing yet shifting calls for publics to actively form relations to and be involved in the governance of technoscientific innovations. These calls are tied to the promise of democratizing science and technology, which is seen as central for restoring public trust in these institutions (Chilvers and Kearnes 2020; Felt and Fochler 2010; Lövbrand, Pielke, and Beck 2011; Wynne 2006). This participatory turn has led to numerous initiatives for engaging the public in science and technology.

The idea of facilitating the formation of public opinion remains central to many of these initiatives. Public participation events, increasingly set up by professional participation facilitators (Thorpe and Gregory 2010; Bogner 2012), often seek to initiate public engagement on topics most people do not have strong preformed views on, as is often the case with emerging technologies (Felt et al. 2014). Such transient and experimental settings of "invited participation" (Wynne 2007, 106) employ different techniques and tools to produce *opinions*. The forming of opinions by members of the public is often seen as a goal in itself, but participation events often also aim at "capturing" opinions in order to feed them into policymaking processes (Bogner 2012; Lezaun and Soneryd 2007). But what, exactly, are opinions in these efforts? We argue that while the notion of opinion is often taken as self-evident, different interpretations of what opinions are and how they should be formed are highly consequential in shaping relations between technoscience and society.

In this article, we address this understudied aspect (Lezaun 2007) of public participation by analyzing how opinion as an emergent object and category was imagined and produced in a series of German public engagement events called "Genome Editing in Dialogue" (GiD) held in 2018/2019. Genome editing is tied to a promissory discourse of revolutionizing biology and biomedicine (Kelz 2020) and is seen as needing public attention and

democratic deliberation (Jasanoff, Hurlbut, and Saha 2015). Genome editing technology has been the focus of various engagement activities in Germany, where public engagement promotes the forming of opinions by citizens. GiD events explicitly named public "opinion-forming" (*Meinungsbildung*) as their primary goal. We investigate the discursive, material, and practical ways in which this goal was pursued in the initiative and trace how opinions are enacted to bear specific properties, political values, and uses. We thus advance understanding of the pragmatics of opinion-forming: of how opinions, as central categories in public engagement, are enacted and circulated in participation projects.

Focusing on how opinions are enacted allows us to further highlight and explain a central tension in contemporary public engagement exercises: while many public engagement professionals are eager to contribute toward more open and deliberative processes of including the public in science policy decision-making, in practice, public engagement exercises often reproduce divisions such as expert/lay divides or fact/value distinctions that have formed a much-criticized part of earlier types of public participation. By identifying two prevalent goals tied to partially conflicting perceptions and understandings of opinion—open deliberation and "capturing" public opinion—our analysis contributes to a more reflexive understanding of the tensions that participation facilitators navigate when making opinions their central point of intervention in ever-co-evolving relations between technologies and their publics.

Interrogating the Participatory Turn

Citizens' opinions have been regarded as important for the legitimization and governance of science and innovation for several decades now. Participation initiatives in the 1980s and 1990s had focused on educating publics and then "measuring" the resultant "public opinion" about a technological matter (Wynne 1995). Beginning in the 2000s, this deficit model approach was increasingly, at least discursively, replaced with an emphasis on engagement, participation, and "two-way dialog" in European research policy discourse (Stilgoe et al. 2014). Public opinion, as a product of participation events, became treated as valuable input for research governance (Irwin 2006; Lezaun and Soneryd 2007), and the 2000s saw a wide array of new initiatives to foster public participation in science and technology.

This participatory turn was often tied to claims that "opening up" science and technology to lay review would make innovations more socially robust because it would expose them to a wider range of meanings, knowledge,

and values (Stirling 2008; Jasanoff 2011; Leach, Scoones, and Wynne 2005; Nowotny, Scott, and Gibbons 2001). Normative legitimation for such efforts was often drawn from deliberative democratic theory (Lövbrand, Pielke, and Beck 2011), which advocates better collective decision-making through participatory politics and rational will-formation (Bohman and Rehg 1997; Habermas 1984). Proponents argue that collective reasoning by political equals, where claims are advanced, evidence is given, and counterfactuals are considered (Fishkin and Luskin 2005; Ryfe 2002), leads to particularly well-considered and informed opinions as well as better governance decisions (Cobb 2011; Luskin, Fishkin, and Jowell 2002). These participation projects have often prioritized an idealized, deliberative democratic model in which innocent (i.e., previously unengaged but "open-minded") citizens come together to build opinions that can be extracted and taken up in public policy (Lezaun and Soneryd 2007; Irwin 2006).

More recent attempts at "reconstituting participation" (Chilvers and Kearnes 2020, 363) have emphasized the value of mobilization, experimentation, and eventfulness (Horst and Michael 2011; Irwin and Horst 2016; Lezaun and Soneryd 2007). They have argued that participation exercises should not only be regarded as successful when they accurately capture static public opinion (Chilvers and Kearnes 2020); participation events should instead be seen as sites for experimentation, "where participants imagine, test and experiment with their own role in society in general and with their position towards techno-scientific developments in particular" (Felt and Fochler 2010, 16).

While welcoming the participatory turn as a departure from a deficit model approach to public engagement, social science commentators have pointed out how efforts to democratize science through public engagement often fall short. Many participation exercises, despite being ostensibly critical of the deficit model, still reproduce some of its core tenets: experts are often attributed a core role in informing the public, and participation is seen as a mechanism for the public to form an informed opinion on the matter based on the assumption that this will translate into heightened support for science and innovation (Delgado, Kjølberg, and Wickson 2011; Felt and Fochler 2010). A growing body of literature has investigated how political goals, norms, and understandings are inscribed into participation practice, and how that practice interfaces with wider political and economic contexts (Chilvers and Kearnes 2016; Stirling 2008; Rayner 2003). Influencing public decision-making is often cited as the goal of participation, but such influence can rarely be traced (Bogner 2012; Goodin and Dryzek 2006; Smallman 2018; Rowe and Watermeyer 2018; Hagendijk and Irwin

2006), or it is restricted to building support for predetermined technoscientific programs (Thorpe and Gregory 2010; Wynne 2006).

Social science scholars have also questioned public participation's compatibility with established modes of governance (Hagendijk and Irwin 2006). These modes are often bureaucratic, managerial, and solution-oriented, making public opinions that are nuanced and multifaceted "'inconvenient' to the policymaking process" (Smallman 2020, 15). This can lead to situations in which public perspectives are marginalized (Kurian and Wright 2010). The limited impact of participation has been associated with policymaking mechanisms and discourses that perpetuate elite imaginaries that favor technoscientific viewpoints over public perspectives (Smallman 2018; 2020; Welsh and Wynne 2013; see also Rayner 2003), and where publics, viewed as ambivalent and skeptical, are seen as a "problem" for technology development (Kearnes and Wynne 2007).

This has led some to dismiss public participation as mere tokenism (Rowe and Watermeyer 2018)—as efforts to generate democratic legitimacy and pacify protest and controversy (Goven 2006; Kurian and Wright 2010) in times when uninvited public engagement is seen as a threat to innovation agendas (Welsh and Wynne 2013). Thorpe and Gregory (2010, 285) argued that in post-Fordist economies, participation mainly serves to move promissory futures into common perception and to create an innovation-ready social environment by giving participants a "feeling of responsibility, quite apart from whether it devolves real power" (see also Thorpe 2010).

Social science discussions about public engagement exercises have highlighted that prevailing expert policy imaginations and political and economic contexts have kept attempts at public deliberation from attaining the status of open deliberation that has a meaningful impact on policy. In this paper, we show that investigating how *opinion*—a central category and object in public engagement exercises—is enacted at a microlevel can give us insight into why engagement exercises often fail at providing meaningful results.

In doing so, we build on understandings of public engagement that highlight how "the subjects (publics), objects (issues), and models (political ontologies) of participation are actively co-constructed through the performance of collective participatory practices both shaping and being shaped by wider social, political, and technoscientific orders" (Chilvers and Kearnes 2020, 350). Related studies have contributed to unpacking a lingering "residual realism" in participation practice; they show how participation efforts often treat participation, democracy, and "the public" as "highly specific, pregiven, and external categories," adopted unquestioningly into the design of participatory practices (Chilvers and Kearnes 2020, 349).

Scholars have argued that participatory formats enact particular types of governance (Horst 2008) or democracy (Laurent 2011; Jasanoff 2011) and construct certain publics (Kearnes and Wynne 2007; Wynne 2007; Gregory and Thorpe 2010; Felt and Fochler 2010; Smallman 2020). Less focus has been given to how public participation enacts opinion as one of its central categories.

Enacting Public Opinion

In this paper, we analyze how public participation exercises enact "opinions" as a category with specific properties and uses. In doing so, we follow Lezaun's (2007, 147) call for social studies of opinion as epistemic objects:

> Researchers spend a great deal of effort explaining why people have the opinions they have . . . yet they have devoted very little attention to how something comes to be counted as an opinion, to the conditions of possibility for something to become an "opinion."

Opinions are often taken to be "unproblematic objects (and) unmediated expressions of people's beliefs" (Lezaun 2007, 147), yet considerable work goes into producing them. Lezaun (2007, 142) has studied how focus groups are designed to enact authentic, individual opinions as distinct from definitive knowledge, which can be extracted by "inciting people to formulate views and judgements" on a given topic. The design and conduct of focus groups is characterized by a specific "political epistemology" (Lezaun 2007, 130), a theory of how opinion should be produced, its validity, and scope. This epistemology is political insofar as it is tied to moral, normative, and political assumptions and uses; it gives rise to what Lezaun (2007, 132) calls the "political constitution" of focus groups. This notion draws our attention to the ways in which opinions as emergent phenomena are coproduced with particular forms of social order and to the political consequences that certain enactments of opinion have.

In tracing the pragmatics of opinion-forming, we are viewing participation exercises as a method that not simply represents a distinct reality but actively brings ("enacts") it into being (Law 2004). In our case what is enacted is opinion as an emergent category and object.

Methods and Case

This paper is based on an ethnographic case study of a series of public engagement events in the German Genomchirurgie im Diskurs (GiD)

project. GiD was organized in 2018/2019 by Wissenschaft im Dialog (WiD), a leading organization for science communication in Germany which develops and employs new public engagement formats to "promote discussion and exchange about research in Germany" (WiD, n.d.b). The GiD project was funded by the German Federal Ministry of Education and Research. It aimed to promote public dialog about emerging genome editing applications related to medicine and public health by organizing so-called Lower-house Debates (LHDs) and simulation games. WiD invited us to carry out an accompanying social science study of these events, giving us complete freedom as to the specific content and objective of this research.

For this paper, we focus on analyzing three LHDs that took place in different German cities and had forty to eighty participants each. According to a report by the GiD organizers, "the LHDs were built in a way that allowed access to the topic even without prior knowledge" (GiD 2019, 4), which suggests that GiD aimed to address a wide public. Participants were recruited through flyers distributed at public event locations, libraries, and schools, which led to a self-selected set of participants. GiD (2019, 23) did not achieve their goal to "attract a representative part of the public," as they acknowledged in their report, arguing that events about such complex topics predominantly reach already engaged and interested audiences. According to the organizers, reasons for participation ranged from a professional interest in the topic (e.g., teachers or students of biological subjects) to being personally affected (e.g., having cancer or hereditary diseases) and being interested in attending an educational event (GiD 2019).

The LHDs were ninety minutes long (thirty minutes of expert input and sixty minutes of interactive participation and discussion). The expert inputs sought to introduce the technical and scientific aspects of genome editing as well as its social, ethical, and legal implications. Specific topics varied between events, with some focusing on public health applications such as population control of malaria-transmitting mosquito species through gene drives, and some focusing on medical applications such as CAR-T cell therapy for leukemia.

Our analysis draws on three kinds of material. First, we studied the LHD events in situ, taking field notes as overt, nonparticipating observers. We recorded audio and fully transcribed the proceedings. We paid special attention to the spatial setup of the rooms, the different tools employed to facilitate discussions, and the ensuing dynamics. Secondly, we conducted semi-structured qualitative interviews with seventeen participants, which took place immediately after the event and were three to fifteen minutes long. These interviews were fully recorded and transcribed and gave us

insights into the experiences, concerns, and expectations of participants. Thirdly, we turned to GiD's two project reports (GiD 2019; Schlender et al. 2019) and websites (WiD n.d.a, n.d.b; GiD n.d.) to analyze how the organizers publicly communicated their idea of opinion-forming, allowing us to reconstruct GiD's "institutional framing" (Irwin 2001) of opinion-forming. Our analyses were aided by the software tool MaxQDA and followed grounded theory methods for coding and memo writing (Charmaz 2006). All direct quotations are our own translations from German into English. Participants in the LHDs were informed by GiD about our study before participating, and we asked our interview partners for additional, informed consent.

Findings

Institutional Framing of Opinion-forming

GiD's public engagement exercises explicitly aimed to "give the public the opportunity to form their own opinions and to engage in lively debate with scientists and policymakers" (WiD n.d.b) on the potentially controversial issue of genome editing. But what exactly does "opinions" mean in this context? A closer look at how the project was officially depicted and promoted reveals two distinct objectives tied to opinion-forming, each corresponding to different understandings of opinions and their political value and utility.

On the one hand, the LHDs were depicted as exercises in open, public deliberation. On its website, GiD is described as a "discussion project that wants to promote discourse about genome editing on multiple societal levels and facilitate informed debate" (WiD n.d.a). Moderators suggested that getting involved with and forming opinions on genome editing qualify participants to take part in broader public debates, and participants were encouraged to engage in further discussions on the topic of genome editing beyond the event. The participation event was thus positioned as being part of a larger process of civic opinion-forming.

The aim of facilitating an open process of opinion-forming stood contrary to another repeatedly stated goal to capture public opinion. In official documents, the project goal was partly framed as a public assessment of genome editing that allows feeding "public opinion" into the political arena. On its website, GiD put this as follows: "The participants are animated to form an opinion and to express themselves. The collected results will eventually be relayed back to [stakeholders from] politics and science"

(GiD n.d.). GiD's funding proposal was particularly rife with claims to capture public opinion: "The participants should, as a result of this appraisal, generate an assessment of the opportunities and risks of genome editing in a discussion paper" (BMBF n.d.). The GiD project here is portrayed as a "participatory technology assessment" (Rowe and Frewer 2005), where public opinions on technological applications are elicited and documented. This framing, however, was contradicted in later GiD reports where the organizers distanced themselves from the goal of documenting opinion results (Cross 2019). We explore this tension below.

Two distinct epistemologies of opinion (Lezaun 2007) were present within the institutional framing (Irwin 2001) of the public engagement exercises: on the one hand, opinions were taken as provisional and emergent views, and as integral parts of ongoing civil deliberations. On the other hand, opinions were also framed as fixed entities held by individuals and collectives, which can be extracted and fed into political decision processes. We now turn to how these contrasting epistemologies of opinion were reflected in the actual design and dynamics of the LHDs.

Information Phase: Expert Input as a Base for Opinion-forming

Each LHD started with an information phase, which sought to provide a "common informational base" upon which participants could build their opinions. Two invited experts—a scientist specialized in developmental biology or a cognate field, and an ethicist or legal specialist—each gave a ten-minute presentation on genome editing and its ethical implications, followed by a brief Q&A. For example, at one event, a developmental geneticist gave a basic introduction into CRISPR-Cas9 and possible applications in humans and other animals. Following this, a lawyer presented a legal perspective on somatic and germ-line genome editing applications in humans.

GiD's rationale for providing expert input first was to "allow access to the topic even without a lot of prior knowledge," as stated by the moderator at one of the events. In other words, existing knowledge was not an entry requirement, making the LHDs a low-threshold engagement opportunity. However, the absence of such a requirement was explicitly linked to the knowledge that participants were given by the invited experts. This demonstrated the degree of importance GiD attached to substantive knowledge for the citizens' ability to meaningfully participate. Decoupling the information phase from a subsequent discussion phase suggests that participants had to first be informed in order to be able to form and discuss their opinions

(Felt et al. 2014). This resonates with how one of the organizers formulated the main goals of GiD: "First, the participants should be able to inform themselves and, second, they should be encouraged to form and express an opinion" (Cross 2019). Similarly, at one event, the participants were told: "after you have listened to these talks and thought a bit about them, you should *then* build an opinion." Facts, seen as the value-free domain of certified experts, should form the basis of but were separated from opinions, which were seen as being tied to subjective values held by the public.

Positioning Phases: Physical Positioning and the Meinungsbild

The two expert presentations were followed by a positioning phase that encouraged the forming of opinions through the special setup of the event room. Chairs for the audience were positioned in two opposite rows. In each of up to ten positioning phases, participants were asked a yes/no question (see Box 1) and instructed to indicate their answers by seating themselves either on the side labeled "yes" or on the side labeled "no," which often resulted in a lively commotion.

Box 1. Examples of Discussion Questions from Different GiD Lower-house Debates (LHDs).

- There are researchers who warn against the hasty use of CRISPR-Cas technology. Are you concerned by these warnings?
- In the future, CRISPR-Cas could be used to modify pig organs for human implantation. They could provide livers, hearts, and other organs for transplants. Should that be allowed in Germany?
- There is now, theoretically, the possibility not to kill malaria-transmitting mosquitoes but instead to genetically modify them. Do you think it would make sense to fight the disease in this way?
- Women with so-called breast cancer genes develop breast cancer with up to 70 percent certainty. They can reduce their risk through amputations. Gene therapy could offer a new possibility to reduce the breast cancer risk for women who have an increased risk. Should these women be offered gene therapy with CRISPR-Cas?

This technique, aimed at increasing the inclusivity of participant engagement by allowing all participants to express their opinions simultaneously (GiD 2019), had specific consequences for how opinions were formed, represented, and experienced. Seating oneself on either row became an embodied experience in which positions were both material and figurative, as physical positioning gave material form to participants' opinions. These positionings were visible to everyone present in the room, resulting in what GiD calls a *Meinungsbild* (from German *Meinung* "opinion" and *Bild* "picture"). This German term denotes an overview of different opinions that may come in the form of a graphic representation. As a metaphor, it emphasizes the visual aspect of opinions, and is at the center of how the public engagement exercise is described on the project website:

> By choosing their seats, [citizens] express their opinions—like in the English Lower House. Thus, seating positions are changed over and over again during the discussion and a *Meinungsbild* toward the different aspects of the topic becomes apparent. (WiD n.d.a)

Since positioning is a form of expressing individual opinion (whether a participant agrees with a particular stance) the observable *Meinungsbild* presented the opinions on a given genome-editing application in an aggregate form that made visible for the participants and facilitators how the rest of the room understood the issue. One moderator explained that this helps to build a better picture of all opinions in the room since "we cannot ask everyone." The positionings were thus a technique with which participants could express themselves quickly and easily, albeit only in a dichotomized yes/no scheme.

Opinion-forming at the LHDs took place in an embodied and intuitive manner. One participant described her experience as: "You sat, hence you . . . took a 'seating point' and already made a statement without necessarily having to say something—but you could reflect on whether you felt comfortable [with this position]." Another participant described his opinion-forming process similarly: "I am very undecided and cannot properly reason through it. Hence, I kind of strongly based my decision on my guts. It just keeps going through my head whether I am sitting in the right position." Many participants took the LHD as an opportunity to experiment with positions on genome editing, indicating that their positionings remained subject to further evaluation in a rather intuitive manner, for example, by switching between the two rows of chairs. This allowed participants to tentatively "feel out" the positions they assumed to

determine whether they felt—physically and figuratively—comfortable with a position.

The LHD format further accommodated such experimental and tentative endeavors in opinion-forming. Moderators explicitly emphasized that participants might change their minds over the course of the discussion and encouraged them emphatically to readjust their physical position accordingly. Asking participants to seat themselves according to a yes/no scheme may seem reductive at first glance, yet this technique encouraged positionings—and, by implication, opinions—that were experienced as intuitive, tentative, and dynamic. This experience was further enhanced by the discussion phases that followed each positioning.

Discussion Phases: Open Deliberation

While the positioning part of the LHD exercise took less than two minutes each and produced quick and simplified opinion expressions, the discussion phases took up to ten minutes per round and aimed to facilitate a more sophisticated exploration of opinions. After each positioning phase, moderators approached participants and asked them to share their reasons for where they had seated. One moderator explained: "I will ask you now and then: Why are you sitting here?—And then every answer is equally good." Through the processes of explicating premises, giving reasons, and developing lines of argument, "positions [were] elaborated and deliberated upon" (GiD 2019, 12). The discussions encouraged participants to share more complex views, so that the initially dichotomized positions were recontextualized and reramified, and contingencies and ambiguities were highlighted. Three characteristic aspects bolstered this opening-up: the active (re)interpretation and contestation of yes/no questions by participants, an undiscriminating juxtaposition of different issue interpretations and reasonings and an overall nonjudgmental view of opinions.

In all the discussions we observed, it quickly became apparent that interpretations of the yes/no questions diverged. For example, participants found themselves disagreeing on what the following question implies:

> If gene drives could be used to make the mosquitoes unable to transmit malaria—the mosquitos could just live a peaceful happy life, keep biting and sucking blood, but they would not transmit malaria anymore. Do you think it is reasonable to fight this disease in such a way?

One participant asserted: "Yes, I am sitting here [at 'yes'], because the question implies that . . . nothing bad—whatever that may be—will happen," while another participant sitting at "no" did not see the preclusion of undesirable side effects implied in the question, arguing that "the risk-question is not settled." Moreover, some participants (re)defined the questions by proactively adding specifications to a question. Take the example of the question: "Do you think that it will be possible to eliminate this disease [i.e. malaria] completely?" One participant explained:

> The question is not formulated precisely enough for me; I am missing a time scope. [I am at "yes"] because I can imagine very well that in 100–200 years, prosperity will have reached Africa . . . then they will have hospitals everywhere, then they will have the means to quarantine people everywhere. If the question here was asked about 20, 30, 40 years, then I could imagine sitting on the other side.

Another participant wondered: "Is the question ['Do you think it is right to offer HIV patients gene therapy?'] about somatic or germline gene therapy—because my answer depends on that." Such elucidations of participants' positions illustrate the sense of contingency that publics exhibit when forming opinions on technoscientific matters (see also Smallman 2018).

At one particular event, participants started frequent meta-discussions on the ambiguity of the questions. A pattern emerged in which each discussant first defined the question in their own terms before answering it. The moderator picked up on this by beginning to ask participants when offering the microphone to them: "Do you also want to say something about how you understood the question?" She made remarks such as: "Now I'll ask the other side again. Maybe it was understood completely differently on the other side," setting the expectation that multiple different interpretations of the question might coexist and that they are worthy of being introduced into the discussion in their plurality. The moderator thus displayed ongoing responsiveness to controversy and emergence, facilitating a particular form of "reflexive experimentation" (Chilvers and Kearnes 2020, 367). She aimed to expose participants to a maximal diversity of interpretations, rather than trying to narrow down and clearly determine the issues. The diverse—indeed, sometimes incommensurable—interpretations were left standing juxtaposed when the moderator proceeded to the next question.

At least as diverse as the question interpretations were the argumentative resources that participants drew on. For instance, when asked about genetically modified pig organs for human transplantation, people presented

completely different reasons for rejecting the application. One participant raised concerns that transplants could endanger the health of the recipient, while another approached the question from an animal rights perspective. Each may or may not have given credence to the argument that the other made, even though they sat on the same side. The exchange of reasons in the discussion phases allowed glimpses into the diversity of value judgments and viewpoints that underlie the ostensibly simple yes/no positionings.

Along with this, very open-ended and deliberately nonconclusive exploration of issue interpretations and reasonings came a certain depoliticization of opinions. A notable instantiation of this was in a moderator's introductory statement:

> An opinion coming from your gut, just a feeling, is equally valuable as one that is well-informed. The first part [of this event] is about factually correct information and the second part is about what moves people when they discuss it—and I want to capture as many opinions as possible.

This pointedly nonjudgmental view of opinions lends a relatively "unproblematic status" to opinions as compared to factual claims (Lezaun 2007, 147). By attributing different parts of the LHD events to factual information and opinion-forming, the moderator suggested that facts and opinions should be treated differently: while information was required to be "factually correct" and was subject to judgment based on its accuracy, opinions were exempt from the same expectations. In an attempt to encourage participants to "frankly state [their] opinion," the moderator assured them that opinions would not be judged. Gut feelings were placed on an equal footing with opinions formed through careful consideration of pertinent information. This view renders opinions unproblematic epistemic objects that are always considered valid and worth "capturing." Opinions are thus shielded from the scrutiny that knowledge or pieces of information are routinely subjected to, namely how rigid the methods of their production were (Lezaun 2007, 132) and how "correct," as one moderator put it, they are.

These examples show how the discussions were moderated in a way that encouraged an experimental and provisional elaboration on a diversity of question interpretations, considerations, and reasonings. The social situation was orchestrated so that opinions appeared as something that could and should be openly expressed, undiscriminatingly juxtaposed, and explored and appreciated in their plurality. According to the organizers, this made the debates less controversial and entrenched, contributing to "mutual trust and

understanding for diverse positions" among the participants and thus ultimately to "enriching societal discourse" (Schlender et al. 2019, 5). Accordingly, the proceedings remained open and deliberately nonconclusive, as no agreements on strict definitions or consensus on lines of reasoning were pursued.

Moments of Contestation

The process of enacting opinions as open and manifold did not remain unchallenged. It was met with explicit contestation by some participants, and it stood in tension with the GiD's other expressed goal: capturing public opinion in order to reflect it to policymakers and other stakeholders.

This became evident when the participatory exercises themselves became a source of controversy due to clashing views on how to form, represent, and utilize opinions. For example, some commotion sparked in one LHD when participants complained about discussion questions being too imprecise. One participant vocally requested a clarification of a question:

> Lest I don't sit at the wrong side again . . . I belong to the group of people who did not quite understand the questions in the sense in which, I believe, you meant them.

In this statement, the participant implied that she assumed GiD wanted the questions to be understood in a single, specific way and indicated that it was important for her to position herself in adherence with this "right" understanding. Asked if participating made him change his opinion, another participant commented: "The question is: opinion *on what*? Because [the discussion questions] really missed the point: the question of 'CRISPR-Cas yes or no' was hardly discussed at all." Speaking about his expectation that the event should provide clear input into policymaking, he added: "A politician is here, which is already quite positive . . . but I imagine that, with more precise question phrasings, the format would be more effective."

These requests and complaints show how some participants had unmet expectations. They anticipated the participation format would be "effective," as the participant above phrased it, in the sense of providing insights into participants' opinions on fixed question-objects, so that unambiguous results could be drawn from the process. This expectation, which was implicitly formulated in these and similar statements, appears to be rooted in an understanding of opinions as relatively stable epistemic objects

that can be extracted from citizens via question-answer technologies, with the goal of providing input for policymaking (see also Irwin 2006; Lezaun and Soneryd 2007). Participants' complaints that the questions were imprecise and thus ineffective in producing opinions to inform policy, called into question what they saw as the very point of the exercise. This also became evident in feedback from select participants at an evaluation workshop on GiD: they wished that "the project results should be fed more into the political process," flagging this as an explicit point for improvement of the LHDs format (Schlender et al. 2019).

Another tension existed between how GiD announcements presented the utility of capturing opinions before the project started as opposed to the documentation afterward. GiD websites (WiD n.d. a, b) and funding proposals (BMBF n.d.) had emphasized the goal of reflecting public opinion back to policymakers. Yet informing decision-makers was not restated as a goal in the reports. In fact, in a reflection piece after the project concluded, one GiD organizer stated that "it was less important that concrete decisions were made at the end because the results were not supposed to inform politics or research" (Cross 2019). Initially, opinions had been presented to public audiences and funders as useful pieces of information for policy, but GiD later distanced itself from this perspective and emphasized the open-ended process of citizen opinion-forming instead.

Representing participants' opinions based on the open-ended and experimental processes that led to producing the opinions in the first place ultimately proved rather challenging for GiD. The organizers ended up abandoning their initial promise of producing an assessment of genome editing, that is, eliciting and documenting opinion results. At the LHDs, we only saw one organizer take notes during discussions but did not observe any more systematic data collection. Discussions were not recorded and there were no surveys conducted. This lack of formal documentation mechanisms, as well as ambiguous question phrasings and facilitators' acceptance of simultaneous diverging interpretations of the questions made attempts at drawing conclusions about participants' opinions very difficult.

Yet, in view of funders' expectations, GiD could not completely eschew proffering the opinions enacted in the debates. The GiD (2019) project report did include statements about public opinion on genome editing applications. Given the absence of any formal documentation at the events, it is perhaps unsurprising that the conclusions drawn about citizens' opinions were sparse and that the "assessments" were worded very cautiously. In order to make generalized statements about participants' opinions, their yes/no positionings were translated into singular, watered-down

propositions about tendencies of the audience to be either "open" or "critical" toward a particular application: "The audience was open toward somatic gene therapy in all cities . . . the application of gene drives in insects was assessed as critically as its application in mice" (GiD 2019, 15). These reported opinion results appear to be derived from observations of participants' physical positioning, where the organizers roughly counted and noted the number of people on each side, but with minimal reference to the discussions, whose contents were summarized in a single page of the report (GiD 2019). This resulted in losing insight into the complexity and plurality of citizens' opinions. At workshop discussions moderators had gone to great lengths to tease out as many different opinions and ideas as possible, eliciting a diversified *Meinungsbild*. By contrast, the summary in GiD's report drew a streamlined, coherent picture that only represented the majority of positions.

Machineries for Making Opinion

Critical analyses of public engagement events have often focused on how publics are constructed in public participation events (Kearnes and Wynne 2007; Wynne 2007; Thorpe and Gregory 2010), pointing out how these events, in the words of Felt and Fochler (2010, 219), form "machineries for making publics." Following Lezaun's (2007) call to study opinions, we have taken a connected but contrasting approach by providing a detailed, microlevel account of how opinions were formed and produced within a series of public engagement events on genome editing. These events can be understood as machineries for making opinions: carefully crafted sociomaterial assemblages that provide techniques, practices, and procedures for enacting "opinions" as epistemic objects. As such, public engagement events preframe the issues that opinions are to be formed on, prescribe how participants can express themselves (Felt and Fochler 2010), and contribute to mediating the relationship between public opinion and the institutional political process within a larger political culture and system (Dryzek and Tucker 2008). These machineries are based on and reproduce specific political epistemologies (Lezaun 2007)—that is, implicit understandings and perceptions of what (legitimate) opinions should look like, how they should be formed and collected and for which ends, and how they should be valued. These epistemologies are deeply political as they are tied to ideas of how these opinions relate to processes of public deliberation and political governance (Horst 2008).

In our case study, we have seen a multiplicity of enactments of opinion. These are tied to two contrasting political epistemologies of opinion. One is an understanding of opinion-forming as an open process, in which opinions are treated as emergent, contingent, and dynamic. The other resembles more classical understandings of opinions as stable pieces of information that can be captured by participation projects as "technologies of elicitation" (Lezaun and Soneryd 2007) in order to be fed into institutional-political processes.

The conduct and design of participation events at GiD largely reflected a political epistemology of opinion that is process-oriented and characterized by multiplicity and openness. The LHDs facilitated varied procedures and practices for enacting opinions that combined elements of physical movement, spatial visuality, and spoken communication. Moderated discussions stimulated more talk-centric, deliberative modes of opinion-forming, in which issue definitions, understandings, and reasonings were explicated and juxtaposed in their plurality. In addition to this, the positioning phases allowed participants to experiment with their positions toward different genome editing applications in a more embodied, intuitive, and tacit manner, creating a simplified and easily readable yet dynamic collective *Meinungsbild*. Through this overall setup, opinions were enacted as tentative, dynamic, contingent, and diverse, and they were valued undiscriminatingly.

Moderators, who repeatedly stressed that it was acceptable to hold differing opinions, aimed to generate what Lezaun (2007, 140) has called an "isegoric situation": a "safe" and nonjudgmental space where everybody was encouraged to form and express their opinion equally, and where contradicting opinions could stand next to one another without conflict. This "safeness" of holding opinions was achieved by decoupling of opinions both from "facts" and from specific consequences. A clear fact/value distinction reminiscent of traditional policy imaginaries (Smallman 2020; Jasanoff 2011) informed the whole process: opinions should be based on but separate from facts; in turn, they are seen as legitimately tied to values, whereas facts are not. While facts are positioned as objective in this particular political epistemology, opinions are seen as provisional and open to revision. As a result, it is the formation of opinions that is valued, not their specific content—seemingly depoliticizing opinions and rendering them inconsequential.

This form of valuing opinions can, however, create tensions with how opinions are valued in other institutional contexts, where more focus may be placed on measurability and the "usefulness" of opinions, and where sophisticatedly articulated public opinions may quickly appear "inconvenient," as

Smallman (2020, 596) has argued in her work on policy resistance to public perspectives. We observed similar tensions in how participants partly contested the fluidity and provisionality of expressed opinions, perceiving the resulting opinions as inconsequential. Their view referred to a very different political epistemology—that is, an implicit understanding of how opinions should be formed and tied to political processes, where systematic procedures should produce clear, identifiable opinions that can be harvested to be fed into political decision-making processes. This contrasting political epistemology arguably represents a more traditional and "realist" view of the goal of public engagement exercises (see Chilvers and Kearnes 2020), which shaped participants' expectations that were subsequently not met: to be taken seriously, participants insisted that their opinions should be synthesized and depicted in a clear, coherent form that could then be relayed to policymakers. This more realist political epistemology of opinion was also present in how the GiD team presented the project to the outside world, for example, by promising they would "capture" and "reflect back" public opinion, catering to policy expectations of quantifiable output prevalent within contemporary audit cultures (Power 1997).

The team behind GiD thus pragmatically engaged in two contrasting political epistemologies of opinion. While the events were represented to policymakers as an opportunity to extract opinions as clear-cut objects compatible with the policy process, in reality, opinions were enacted as much more fluid and procedural objects, thus prioritizing openness and the process of deliberation over the documentation of opinion-results. Far from emphasizing values such as "moderation, 'realism' and consensus," which Thorpe and Gregory (2010, 294) described as typical for an engagement community whose key function is supposedly to legitimize policy outcomes, the members of GiD actively tried to work within and subvert the framing conditions of their work to produce what they themselves seemed to regard as more democratic forms of public engagement. In doing so, however, they faced resistance by a lingering and forceful presence of what we have described as a more realist political epistemology of opinion.

Struggling to Open Up Public Engagement

In recent years, public engagement professionals have increasingly engaged with deliberative theory, trying to stage multifarious processes of deliberation to foster more nuanced, reflexive, and democratic decision-making on science and technology (Curato et al. 2017; Selin et al. 2017). These practices have been informed by social science scholarship that criticized earlier

participation activities for attributing a passive role to members of the public, prematurely narrowing the scope of opinions (Horst and Irwin 2010) and closing down controversial issues (Moore 2011). Avoiding these tendencies, Genomchirurgie im Diskurs (GiD) can be seen as an example of recent attempts to facilitate forms of deliberation that render opinion-forming into multiple dynamic, flexible, and open-ended processes instead of focusing on the production of clearly defined "opinions" as unproblematic and immutable epistemic objects that can easily circulate in the policy process. This is in step with new, more "speculative, creative, and designerly" participation approaches, which "allow for and actively prompt multiple attachments, framings, and purposes" (Chilvers and Kearnes 2020, 358; see also Michael 2012; Irwin and Horst 2016).

Involving a pragmatics of opinion that includes physical positioning as a way of dynamically forming and expressing viewpoints, the LHD format offers a complementary mode of opinion-forming to the traditionally disembodied, talk-centric forms of deliberative democracy (e.g., Habermas 1984). An embodied and tacit mode of opinion-forming allows for experimenting with positions by "feeling them out;" it resonates with recent efforts in deliberative democracy and public engagement to inclusively involve multiple forms of communication (Curato et al. 2017), including nonverbal, bodily expression (Davies 2014; Selin et al. 2017).

At the same time, our analysis of GiD also shows how attempts to engage publics in more dynamic, tentative, and experimental ways are confronted with subtle mechanisms and processes through which opinions are rendered as singular and static, which may be at odds with engagement professionals' own aspirations.

There are several reasons for the persistence of what Chilvers and Kearnes (2020, 350) have termed a "residual realist imaginary of participation." One reason highlighted in our study is a powerful and deeply ingrained political epistemology of opinion. This epistemology shapes expectations about how opinions should be formed and exerts pressure on engagement processes to produce opinions that are compatible with policy logics. Political processes in the context of representative democracy may require the construction of a clearly defined "public opinion"—a process that, as with any form of representation, is prone to violently gloss over a diversity of standpoints in its aim to synthesize and summarize, even if the detail and diversity of expressed opinions is lost. Such realist epistemologies are, as we have shown, not only externally imposed but a vocal demand of some participants who wish their voices to be "effective." This echoes a basic dilemma for a deliberative practice aiming to explore

a wide range of diverse viewpoints as described by Ryfe (2005): the more open and process-oriented a deliberative exercise is, the less participants feel that something is at stake, or that they are accountable for an outcome, which contradicts their motivations to participate in the first place.

A further reason for residual realism is tied to the mechanisms of opinion-forming inherent to the deliberative setting itself. We have shown how the logic of participatory events paradoxically tends to reproduce a fact/value distinction that is antithetical to deliberation understood as a political negotiation. This distinction is similar to the one embedded in policymakers' elite imaginary described by Smallman (2020; 2018) and resonates with "more-than-rational political or affective strategies" in public engagement that aim to produce public enthusiasm for new technologies, while casting publics into a passive role (Kearnes and Wynne 2007, 137; Wynne 2007). In trying to provide a "safe space" where opinions can be openly voiced by the public, public engagement professionals separate facts from values, rendering opinions safe, but ultimately ineffectual. The opinions produced, in the form of fleeting and contingent value judgments, fail to meet the criteria for what are considered "correct" forms of evidence in a political decision-making process that relies on an elite imaginary of "science to the rescue" (Smallman 2020) that privileges objective facts over deliberative processes.

Opinions, through this political epistemology, are kept separate from policy decision-making, leaving publics and their perspectives marginalized—not just by elite policy discourses and strategies but also through the very workings of engagement exercises. Efforts to democratize science through public participation, despite participation professionals' ambitions to enact real and meaningful forms of deliberation, remain ambivalent. Our analysis shows how, when engagement exercises mainly serve to perform a public duty of "openness," and where the formation of opinions becomes the central point of intervention, it results in a depoliticization of public perspectives. As a result, engagement exercises still play a largely legitimizing role with little tangible impact in policy contexts. At the same time, our analysis has shown how these settings form places for learning, where opinion-forming takes place in a creative, tentative, and embodied form. As public engagement professionals have to navigate competing demands that are tied to two distinct political epistemologies of opinion, the resulting forms of engagement are both empowering and disempowering: they are empowering because they give participants the opportunity to explore their standpoints and to shape their relations to technologies in open-ended processes of social experimentation (Selin et al. 2017; Davies et al. 2009;

Chilvers and Kearnes 2016) but also simultaneously disempowering because the resulting knowledge is not fed into the policymaking cycle in a way that meaningfully influences policy.

This leaves us with a question: What is the value of participation exercises when their ability to facilitate truly meaningful deliberative practices—the formation of opinions as a dynamic process that is nevertheless consequential in forming policy—is constrained by both external structures and internal logics that render the resulting opinions apolitical and inconsequential? As long as public engagement exercises are seen as an add-on, exterior to the policymaking process itself, taking place in safe yet sequestered spaces, they are prone to be perceived as ineffective. It is the machinery of policy itself that needs to change so that alternative forms of knowledge and public perspectives can be meaningfully included.

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References

BMBF. n.d. "Genomchirurgie im Gesellschaftlichen Diskurs." Accessed July 6, 2021. https://www.gesundheitsforschung-bmbf.de/de/gcd2017-18-genomchirurgie-im-gesellschaftlichen-diskurs-7154.php.

Bogner, Alexander. 2012. "The Paradox of Participation Experiments." *Science, Technology, & Human Values* 37 (5): 506-27. doi: 10.1177/0162243911430398.

Bohman, James, and William Rehg, eds. 1997. *Deliberative Democracy: Essays on Reason and Politics*. Cambridge, MA: MIT Press.

Charmaz, Kathy. 2006. *Constructing Grounded Theory: A Practical Guide Through Qualitative Analysis*. London, UK: Sage.

Chilvers, Jason, and Matthew Kearnes. 2016. "Participation in the Making: Rethinking Public Engagement in Co-productionist Terms." In *Remaking Participation: Science, Environment and Emergent Publics*, edited by Jason Chilvers and Matthew Kearnes, 31-63. London, UK: Routledge.

Chilvers, Jason, and Matthew Kearnes. 2020. "Remaking Participation in Science and Democracy." *Science, Technology, & Human Values* 45 (3): 347-80. doi: 10.1177/0162243919850885.

Cobb, Michael D. 2011. "Creating Informed Public Opinion: Citizen Deliberation about Nanotechnologies for Human Enhancements." *Journal of Nanopartical Research* 13 (4): 1533-48. doi: 10.1007/s11051-011-0227-0.

Cross, Arwen. 2019. "Unterhausdebatten Und Planspiele—Meinungen Erwünscht." Accessed November 9, 2022. https://www.wissenschaftskommunikation.de/unterhausdebatten-und-planspiele-meinungen-erwuenscht-27147/.

Curato, Nicole, John S. Dryzek, Selen A. Ercan, Carolyn M. Hendriks, and Simon Niemeyer. 2017. "Twelve Key Findings in Deliberative Democracy Research." *Daedalus* 146 (3): 28-38. doi: 10.1162/DAED_a_00444.

Davies, Sarah. 2014. "Knowing and Loving: Public Engagement beyond Discourse." *Science and Technology Studies* 27 (3): 90-110.

Davies, Sarah, Ellen McCallie, Elin Simonsson, Jane L. Lehr, and Sally Duensing. 2009. "Discussing Dialogue: Perspectives on the Value of Science Dialogue Events That Do Not Inform Policy." *Public Understanding of Science* 18 (3): 338-53. doi: 10.1177/0963662507079760.

Delgado, Ana, Kamilla Lein Kjølberg, and Fern Wickson. 2011. "Public Engagement Coming of Age: From Theory to Practice in STS Encounters with Nanotechnology." *Public Understanding of Science* 20 (6): 826-45. doi: 10.1177/0963662510363054.

Dryzek, John S., and Aviezer Tucker. 2008. "Deliberative Innovation to Different Effect: Consensus Conferences in Denmark, France, and the United States." *Public Administration Review* 68 (5): 864-76. doi: 10.1111/j.1540-6210.2008.00928.x.

Felt, Ulrike, and Maximilian Fochler. 2010. "Machineries for Making Publics: Inscribing and De-scribing Publics in Public Engagement." *Minerva* 48 (3): 219-38. doi: 10.1007/s11024-010-9155-x.

Felt, Ulrike, Simone Schumann, Claudia G. Schwarz, and Michael Strassnig. 2014. "Technology of Imagination: A Card-based Public Engagement Method for Debating Emerging Technologies." *Qualitative Research* 14 (2): 233-51. doi: 10.1177/1468794112468468.

Fishkin, James S., and Robert C. Luskin. 2005. "Experimenting with a Democratic Ideal: Deliberative Polling and Public Opinion." *Acta Polit* 40 (3): 284-98. doi: 10.1057/palgrave.ap.5500121.

GiD (Genomchirurgie im Diskurs). 2019. "Dokumentation zu den Veranstaltungen im Rahmen des Teilprojekts„ Genomchirurgie im Diskurs mit der Öffentlichkeit." Accessed July 29, 2019. https://genomchirurgie.de/wp-content/uploads/2019/06/gcd_oeffentlicheveranstaltungen.pdf.

GiD (Genomchirurgie im Diskurs). n.d. *Über uns*. Accessed May 10, 2019. https://genomchirurgie.de/ueber-uns/.

Goodin, Robert E., and John S. Dryzek. 2006. "Deliberative Impacts: The Macro-political Uptake of Mini-publics." *Politics & Society* 34 (2): 219-44. doi: 10.1177/0032329206288152.

Goven, Joanna. 2006. "Processes of Inclusion, Cultures of Calculation, Structures of Power." *Science, Technology, & Human Values* 31 (5): 565-98. doi: 10.1177/0162243906289612.

Habermas, Jürgen. 1984. *The Philosophical Discourse of Modernity*. Cambridge, UK: Polity Press.

Horst, Maja. 2008. "The Laboratory of Public Debate: Understanding the Acceptability of Stem Cell Research." *Science and Public Policy*, 35 (3): 197-205. doi: 10.3152/030234208X302652.

Horst, Maja, and Alan Irwin. 2010. "Nations at Ease with Radical Knowledge." *Social Studies of Science* 40 (1): 105-26. doi: 10.1177/0306312709341500.

Horst, Maja, and Mike Michael. 2011. "On the Shoulders of Idiots: Re-thinking Science Communication as 'Event'." *Science as Culture* 20 (3): 283-306. doi: 10.1080/09505431.2010.524199.

Irwin, Alan. 2001. "Constructing the Scientific Citizen: Science and Democracy in the Biosciences." *Public Understanding of Science* 10 (1): 1-18.

Irwin, Alan. 2006. "The Politics of Talk." *Social Studies of Science* 36 (2): 299-20. doi: 10.1177/0306312706053350.

Irwin, Alan, and Maja Horst. 2016. "Engaging in a Decentered World: Overflows, Ambiguities and the Governance of Climate Change." In *Remaking Participation*, edited by Jason Chilvers and Matthew Kearnes, 64-80. Abingdon, UK: Routledge.

Jasanoff, Sheila. 2011. "Constitutional Moments in Governing Science and Technology." *Science and Engineering Ethics* 17 (4): 621-38. doi: 10.1007/s11948-011-9302-2.

Jasanoff, Sheila, J. Benjamin Hurlbut, and Krishanu Saha. 2015. "CRISPR Democracy: Gene Editing and the Need for Inclusive Deliberation." *Issues in Science and Technology* 32 (1): 25-32.

Kearnes, Matthew, and Brian Wynne. 2007. "On Nanotechnology and Ambivalence: The Politics of Enthusiasm." *Nanoethics* 1 (2): 131-42. doi: 10.1007/s11569-007-0014-7.

Kelz, Rosine. 2020. "Genome Editing Animals and the Promise of Control in a (Post-)Anthropocentric World." *Body & Society* 26 (1): 3-25. doi: 10.1177/1357034X19882762.

Kurian, Priya, and Jeanette Wright. 2010. "Science, Governance, and Public Participation: An Analysis of Decision Making on Genetic Modification in Aotearoa/New Zealand." *Public Understanding of Science* 21 (4): 447-64. doi: 10.1177/0963662510382362.

Laurent, Brice. 2011. "Technologies of Democracy: Experiments and Demonstrations." *Science and Engineering Ethic* 17 (4): 649-66. doi: 10.1007/s11948-011-9303-1.

Law, John. 2004. *After Method: Mess in Social Science Research*. London, UK: Routledge.

Leach, Melissa, Ian Scoones, and Brian Wynne. 2005. *Science and Citizens*. London, UK: Zed Books.

Lezaun, Javier. 2007. "A Market of Opinions: The Political Epistemology of Focus Groups." *Sociological Review* 55 (s2): 130-51.

Lezaun, Javier, and Linda Soneryd. 2007. "Consulting Citizens: Technologies of Elicitation and the Mobility of Publics." *Public Understanding of Science* 16 (3): 279-97. doi: 10.1177/0963662507079371.

Lövbrand, Eva, Roger Pielke, and Silke Beck. 2011. "A Democracy Paradox in Studies of Science and Technology." *Science, Technology, & Human Values* 36 (4): 474-96. doi: 10.1177/0162243910366154.

Luskin, Robert C., James S. Fishkin, and Roger Jowell. 2002. "Considered Opinions: Deliberative Polling in Britain." *British Journal of Political Science*. 32 (3): 455-87. doi: 10.1017/S0007123402000194.

Michael, Mike. 2012. "'What Are We Busy Doing?' Engaging the Idiot." *Science, Technology, & Human Values* 37 (5): 528-54. doi: 10.1177/0162243911428624.

Moore, Alfred. 2011. "Following from the Front: Theorising Facilitation in Deliberative Democratic Practices." Prepared for delivery at the 2011 General Conference of the European Consortium for Political Research, Reykjavik, August 25-27. Accessed April 30, 2024. https://ecpr.eu/Events/Event/PaperDetails/9486.

Nowotny, Helga, Peter Scott, and Michael Gibbons. 2001. *Re-thinking Science: Knowledge and the Public in an Age of Uncertainty*. Cambridge, UK: Polity Press.

Power, Michael. 1997. *The Audit Society: Rituals of Verification*. Oxford, UK: Oxford University Press.

Rayner, Steve. 2003. "Democracy in the Age of Assessment: Reflections on the Roles of Expertise and Democracy in Public-sector Decision-making." *Science and Public Policy* 30 (3): 163-70.

Rowe, Gene, and Lynn J. Frewer. 2005. "A Typology of Public Engagement Mechanisms." *Science, Technology, & Human Values* 30 (2): 251-90. doi: 10.1177/0162243904271724.

Rowe, Gene, and Richard P. Watermeyer. 2018. "Dilemmas of Public Participation in Science Policy." *Policy Studies* 39 (2): 204-21. doi: 10.1080/01442872.2018.1451502.

Ryfe, David M. 2002. "The Practice of Deliberative Democracy: A Study of 16 Deliberative Organizations." *Political Communication* 19 (3): 359-77. doi: 10.1080/0195747029005554 7.

Ryfe, David M. 2005. "Does Deliberative Democracy Work?" *Annual Review of Political Science* 8 (1): 49-71. doi: 10.1146/annurev.polisci.8.032904.154633.

Schlender, Hannes, Caroline Wichmann, Daniela Weber, Anne Faulmann, Markus Weißkopf, Beate Langholf, and Arwen Cross. 2019. "Stakeholder-Workshop zum BMBF-Verbundvorhaben, Genomchirurgie im gesellschaftlichen Diskurs' von Leopoldina und Wissenschaft im Dialog (WiD)." Accessed November 10, 2022. https://www.wissenschaft-im-dialog.de/fileadmin/user_upload/Projekte/Genomchirugie_im_Diskurs/Dokumente/19_GCD_Dokumentation_WorkshopGenomchirurgie.pdf.

Selin, Cynthia, Kelly C. Rawlings, Kathryn de Ridder-Vignone, Jathan Sadowski, Carlo Altamirano Allende, Gretchen Gano, Sarah R. Davies, and David H. Guston. 2017. "Experiments in Engagement: Designing Public Engagement with

Science and Technology for Capacity Building." *Public Understanding of Science* 26 (6): 634-49. doi: 10.1177/0963662515620970.

Smallman, Melanie. 2018. "Science to the Rescue or Contingent Progress? Comparing 10 Years of Public, Expert and Policy Discourses on New and Emerging Science and Technology in the United Kingdom." *Public Understanding of Science* 27 (6): 655-73. doi: 10.1177/0963662517706452.

Smallman, Melanie. 2020. "'Nothing to Do with the Science': How an Elite Sociotechnical Imaginary Cements Policy Resistance to Public Perspectives on Science and Technology Through the Machinery of Government." *Social Studies of Science* 50 (4): 589-608. doi: 10.1177/0306312719879768.

Stilgoe, Jack, Simon J. Lock, and James Wilsdon. 2014. "Why Should We Promote Public Engagement with Science?" *Public Understanding of Science* 23 (1): 4-15. doi: 10.1177/0963662513518154.

Stirling, Andy. 2008. "'Opening up' and 'Closing down': Power, Participation, and Pluralism in the Social Appraisal of Technology." *Science, Technology, & Human Values* 33 (2): 262-94. doi: 10.1177/0162243907311265.

Thorpe, Charles. 2010. "Participation as Post-Fordist Politics: Demos, New Labour, and Science Policy." *Minerva* 48 (4): 389-411. doi: 10.1007/s11024-010-9157-8.

Thorpe, Charles, and Jane Gregory. 2010. "Producing the Post-Fordist Public: The Political Economy of Public Engagement with Science." *Science as Culture* 19 (3): 273-301. doi: 10.1080/09505430903194504.

Welsh, Ian, and Brian Wynne. 2013. "Science, Scientism and Imaginaries of Publics in the UK: Passive Objects, Incipient Threats." *Science as Culture* 22 (4): 540-66. doi: 10.1080/14636778.2013.764072.

WiD (Wissenschaft im Dialog). n.d.a. "Genomchirurgie im gesellschaftlichen Diskurs." Accessed May 10, 2019. https://www.wissenschaft-im-dialog.de/projekte/genomchirurgie-im-diskurs/.

WiD (Wissenschaft im Dialog). n.d.b. "Wissenschaft im Dialog—An Initiative of Germany's Scientific Community." Accessed February 16, 2019. https://www.wissenschaft-im-dialog.de/en/about-us/portrait-englisch/.

Wynne, Brian. 1995. "Public Understanding of Science." In *Handbook of Science and Technology Studies: Revised Edition*, edited by Sheila Jasanoff, James C. C. Peterson, Gerald E. Markle, and Trevor J. Pinch, 361-88. Thousand Oaks, CA: Sage.

Wynne, Brian. 2006. "Public Engagement as a Means of Restoring Public Trust in Science—Hitting the Notes, but Missing the Music?" *Community Genetics* 9 (3): 211-20. doi: 10.1159/000092659.

Wynne, Brian. 2007. "Public Participation in Science and Technology: Performing and Obscuring a Political–Conceptual Category Mistake." *East Asian Science* 1 (1): 99-110. doi: 10.1007/s12280-007-9004-7.

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