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Participatory versus analytic approaches for understanding risk perceptions: a comparison of three case studies from the field of biotechnology

Leonie Dendler^a, Mariana Morais^a, Jan Nikolas Hargart^a, Joana S. Lourenço^b, Domagoj Vrbos^b, Paul Ortega^b, Kamila Sfugier Tollik^b, Georgios Alaveras^b, Barbara Gallani^b, Michelle Patel^c, Laura Broomfield^c and Ortwin Renn^d

^aDepartment Risk Communication, German Federal Institute for Risk Assessment, Berlin, Germany; ^bCommunication and Partnership Department, European Food Safety Authority, Parma, Italy; ^cScience, Evidence and Research Directorate, FSA, UK; ^dResearch Institute for Sustainability - Helmholtz Center Potsdam, Germany (RIFS)

ABSTRACT

Considering growing participatory turns in regulatory scientific risk analysis, this paper compares how social scientists use participatory and analytical methods to understand risk perceptions and meet competing demands for representativeness and inclusiveness. Drawing on case studies of how three European risk agencies use participatory and analytic methods in the context of biotechnology, it confirms difficulties of analytic methods to shed light on perceptions when applied to unfamiliar topics. It also shows the potential of participatory in particular deliberative formats to engage affected populations in the risk analysis process, despite challenges in promoting inclusiveness. The cases call for the integration of methods, while remaining aware of the need to understand the mutual interplay in the constructions of risks and structural inequalities.

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Social science; risk analysis; risk perception; risk communication; participation; deliberation; genome editing

Introduction

While there are many roles for social scientists in risk analysis, shedding light on perceptions and attitudes toward risks has arguably developed into one of the most demanded tasks (Klinke and Renn 2021; Wendling 2014). There is much evidence that risk perception shapes food safety practices (Siegrist and Árvai 2020), is influenced by micro, meso, and macro level factors (Knight and Warland 2005), and has been subject of many analytic studies largely based on surveys (Nardi et al. 2020). In spite of an abundant literature on food risk perception, there is hardly any coverage on the role of different approaches of how to conduct risk perceptions studies (Frewer and Miles 2001; Bieberstein and Roosen 2015; Renn et al. 2022). In particular, there is little agreement about the prospects and limitations of participatory (e.g. participatory forums, roundtables, or deliberative mini-publics) versus analytic (e.g. surveys, focus groups) research approaches.

CONTACT Leonie Dendler 🕲 leonie.dendler-rafael@bfr.bund.de 💽 Department Risk Communication, German Federal Institute for Risk Assessment, Berlin, Germany Max-Dohrn-Straße 8-10, 10589 Berlin, Germany.

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When analyzing risk perceptions, social scientists mobilize a variety of well-established methods. Most dominantly, this includes survey research (Nardi et al. 2020; Gaskell, Hohl, and Gerber 2017), followed by focus group discussion, in-depth interviews, experiments and (social) media analysis. More recently, authors have started to understand the public not as passive sources for data collection, but to involve them in an engaged dialogue with the researchers (Pidgeon 2021; Webler and Tuler 2021). This involves new participatory formats, including the integration of deliberative elements, as a means to create a learning environment for both researchers and participants, adding another layer of legitimacy (Klinke and Renn 2021; Dendler and Böl 2021).

When it comes to the analysis and overall governance of technological risks, such as nanotechnology and, most recently, synthetic biology and genome editing (GE), more participatory, in particular more deliberative approaches, have been increasingly called for and partially implemented (Bruce and Bruce 2019; Carter and Mankad 2021; Kuiken, Barrangou, and Grieger 2021; Pansera et al. 2020; Merkelsen 2011). Under the wider framework of responsible research and innovation (as propagated by the EU Commission) especially the Science and Technology Studies community has advocated to 'inclusively opening up visions, purposes, and dilemmas to broad, collective deliberation through processes of dialogue, engagement, and debate, inviting and listening to wider perspectives from publics and diverse stakeholders' (Owen et al. 2013).

However, few studies have extended this perspective to the institutional context of food risk regulation. This paper investigates the options and challenges social scientists inside risk agencies have in integrating risk perceptions of the affected public in the risk governance process (Webler and Tuler 2021; Wendling 2014). After a brief review of the literature on the role of social science in risk analysis, the paper will present case studies of how three European risk agencies have implemented a variety of methods, including more participatory ones, to shed light on risk perceptions. Using the context of new genomic techniques (NGTs) as an example, it will illustrate the challenges associated with meeting competing demands for representativeness and inclusiveness. The purpose of this paper is not to explore the effectiveness of biotechnology experiments. It rather reflects on the ability of different approaches to assess and interpret tensions between and among different audiences and contribute to a (better) understanding of perceptions, needs and demands in a dynamic learning environment.

Participatory versus analytic approaches to study risk perceptions

The need for more inclusive risk perception studies

There seems to be growing agreement amongst academics and practitioners alike that 'normalized' (Hardy et al. 2020), i.e. purely technical and natural science based, risk analysis can be applied only in rare cases of non-problematic and familiar knowledge. As uncertainty and ambiguity increase, more holistic, inter- and trans-disciplinary approach are needed (Klinke and Renn 2021; Renn 2021; Stirling and Scoones 2009; Hardy et al. 2020; van der Heijden 2021; Wendling 2014) Klinke and Renn (2021), for example, call for a move towards 'post normal' risk governance where risk assessments are accompanied by concern assessment, risk characterization and risk evaluation.

For social scientists, concern assessment has become one of the most prominent and popular tasks (Wendling 2014). According to the International Risk Governance Council (IRGC 2017) concern assessment helps to understand different opinions, values and concerns about risks. It may be able to reveal sociological, organizational, and anthropological constraints, including inequities, and provide insights into processes of political or social mobilization. Although these assessments are still rare in current risk analysis processes, they have the potential to mitigate social amplification of risk, improve communication strategies and the overall risk governance process (Klinke and Renn 2021; Renn 2017; Wendling 2014).

Beyond such predominantly analytic approaches, many call for more participatory and inclusive risk governance. For Renn (2021, 5) an inclusive governance approach aims to ensure the early and meaningful involvement of all stakeholders and civil society through inclusive knowledge production, systematic deliberation and close monitoring of policy impact. This is in line with a general 'deliberative turn' in regulatory scientific risk analysis as well as in other policy domains (Dryzek et al. 2020; Webler and Tuler 2021).

Analytic and participatory methods in social science research

Analytic methods try to provide an accurate representation of what people believe or prefer when asked directly without providing a space for learning or mutual dialogue. This includes, for example, surveys or structured interviews. Participatory and particularly deliberative methods are reflexive and interactive to provide a space for argumentation and mutual learning before risk perceptions are elicited and documented (Renn et al. 2022). They include deliberative consensus conferences (Kluver 1995), citizen assemblies (Bächtiger, Setälä, and Grönlund 2014), citizen juries (Bryson et al. 2013) but also roundtables, workshops or other participatory formats (Pidgeon 2021).

Several methods could fall either into the analytic or into the participatory category: focus groups, un- or semi-structured interviews, and social media studies. Focus groups include group discussions but they often are directed towards calibrating individual preferences rather than initiating an exchange of arguments (Schulz, Mack, and Renn 2012). Other applications of focus groups explicitly include a participatory element of developing a group position towards a specific topic. The same is true for social media studies: Data from social media platforms, such as Twitter, can be used for monitoring online conversations, and for identifying salient signals or deviations from the norm relative to historic data (e.g. in content volume or other indicators). Other media studies provide open platforms for stakeholder engagement or open discourse among different audiences (Nazir et al. 2019; Walsh et al. 2021; Zachlod et al. 2022).

In the 1980s, the Danish Board of Technologies first introduced public deliberation into the assessment of technological risks in form of consensus conferences (Kluver 1995; Dryzek and Tucker 2008). As a 'large and growing research paradigm', deliberative approaches engage both theorists and empirically orientated scholars in creating and testing new interactive research designs (Chambers 2022, 27). The joint epistemic and strategic aims are usually to bring different perspectives to the table, clarifying controversies, producing balanced decisions and contributing to a more knowledgeable, confident and cooperative citizenry. The overall normative goal is to improve policymaking and to enhance legitimacy of decisions as part of an overall democratic reform (Blok 2007; Dryzek et al. 2020; Dendler 2022; Einsiedel, Jelsøe, and Breck 2001; Ureta 2016; Goodin and Dryzek 2006).

Inclusiveness and representativeness: two major criteria for legitimacy

Over the past decades, inclusiveness and representativeness have developed into prominent legitimacy demands concerning risk perception research and overall risk governance (Barker et al. 2010; Pidgeon 2021). Inclusion and representation are often opposed to each other, but are arguably mutually required when studying risk perceptions and designing participatory processes. Individual differences affect risk perception, influenced by sociopolitical factors (Flynn, Slovic, and Mertz 1994; Dosman, Adamowicz, and Hrudey 2001; Siegrist and Árvai 2020; Satterfield, Mertz, and Slovic 2004). For example, while the 'white male effect' demonstrates a lower concern about food hazards and technologies than on average (Flynn, Slovic, and Mertz 1994), nonwhite females are reported to show higher risk ratings than the average (Satterfield, Mertz, and Slovic 2004). As suggested by Flynn, Slovic, and Mertz (1994, 1107), women and black men potentially are more aware of and concerned about risks since 'they

benefit less from many of its technologies and institutions, and they have less power and control.'

Social scientific methods aim to shed light on such plural risk perceptions (Wendling 2014). While surveys promise high generalizability based on their sampling approach, they usually rely upon highly structured verbal reports through questionnaires or fixed-choice interviews. This leaves little room for differentiation and personalized context conditions. Since the pre-formulated items may not represent their risk, it can deter respondents from specific groups to fill in the questionnaire. If some individuals refuse to or are unable to answer the questions, the results are biased towards the mainstream respondent, which raises questions on both inclusiveness and representativeness of the survey (Brewer and Hunter 1989).

Also for social media analysis, establishing the extent to which the study group represents the targeted population emerges as a challenge (Janssens, Cecile, and Kraft 2012). While content is spontaneously provided by the participants themselves, a minority of users, which does not equally represent the whole population, tends to generate most of the content (Ruggiero and Vos 2014; Anderson et al. 2017; Moe and Schweidel 2017).

Focus group discussions do not aim at giving a representative picture of the population at large or the proportions of how opinions and perceptions are distributed among a large population. Instead, they usually aim at recording and documenting a wide range of responses and reactions and at illuminating the social and cultural as well as biographic context in which the perceptions are embedded.

Deliberative methods typically combine random sampling with targeted selection to ensure that a wide range of individual and group viewpoints are represented (Dryzek and Tucker 2008; Rountree et al. 2022). Following deliberation theorists, each viewpoint needs to be represented in the discourse but it is not necessary to reach a statistical representation (Goodin and Dryzek 2006; Lafont 2015). One point to consider when defining the rules for participant selection, is similarity in relation to the topic (Morgan 2012). While homogeneity facilitates interaction, plurality of characteristics and demographics between participants maximizes the range of perspectives within a group context (Kitzinger 1995; Morgan 2012). Deliberative formats are more likely to reach consensus when the participants share a set of common values and beliefs; yet the goal of representing diversity demands to assemble many different opinions and values. This can threaten a common understanding (Renn and Schweizer 2009; Dendler 2022).

There are other approaches to recruit participants, for example for wider participatory formats or focus groups. They target specific audiences or subgroups, such as students or people who are familiar with or have a particular interest in a topic. They are usually not directed towards any kind of statistical or topical representation, but aim to elicit different facets of shared values in homogeneous social settings (Pidgeon 2021; Mey 2020). While these formats help to get a better understanding of viewpoints, many see them as not only breaking the essentials of representativeness but also the essentials of deliberation, i.e. a discursive exchange of arguments in an open and fair environment (Mansbridge et al. 2012).

For critics of the deliberative approach such arguments form an 'idealist' understanding of participation that misses 'how and why actual publics engage with issues' (Gehrke 2014, 77–78). Together with longstanding criticism of the limited impact of deliberative events, this has given rise, amongst others, to calls to include 'active participants' that can 'carry their learning and experience into future activity around the issue' (Kaplan et al. 2021).

Some deliberative (and other participatory) formats entail self-selection elements through open calls for participation (Dryzek and Tucker 2008). However, self-selection often results in a domination by activists, as well as wealthier and better-educated individuals (Dean et al. 2022; Fung 2006; Fishkin 2020). Those who are financially or logistically unable to commit the time and effort, or those who do not feel comfortable speaking up in a crowd tend to be underrepresented. To meet ideals of inclusiveness, some have called to prioritize the voice of underrepresented groups through special selection measures or adapted procedures (Dean et al. 2022;

Pidgeon 2021; Young 2002; Dryzek 1990). Here, again, inherent tensions with overall representation arise (Lafont 2015).

Alternatively or additionally, representation through civil society actors has been proposed as a means to stimulate social and political practices (Avritzer 2002; Cohen and Arato 1992). As stated by Scharpf (cited in Carrick et al. (2022), 'the success of participation depends on an accurate assessment of the indispensable actors and their interests'. Yet, although associated with democratizing properties in the public sphere (Cohen and Arato 1992), it is necessary to 'unpack the category' of civil society (Cornwall and Schatten Coelho 2007) and to understand the representation of pluralist ideas (Avritzer 2002).

The perils of overstressing participatory formats

Typical stakeholders include, for example, associations, civil society groups, local businesses (or their representatives, such as the Chamber of Industry). Due to their position, they are central multipliers, potential amplifiers or barriers to social change. The participation of these stakeholders can therefore play a central role, first, to use their knowledge of local contexts for the identification and evaluation of potential solutions to a problem and, second, to include their interests and concerns (Bell, Morse, and Shah 2012).

Unlike citizen deliberation formats for instance, which are supposed to explore alternatives for society as a whole, stakeholder assemblies are concerned with finding possible solutions that most closely match the common interests of the participating parties. Mixing stakeholders and randomly selected citizens in one format may obscure these differences in logic and rationale (Ehs and Mokre 2021). While both formats may achieve similar results, the different preconditions make this rather unlikely (Beauvais and Warren 2019). More generally, power asymmetries can threaten inclusiveness during the process (Mockler 2022).

To summarize, there is a tension between seeking fair and diverse representation of public interests, the difficulties of recruiting and engaging a random sample and the level of resources and interest that comes from the pool of experts or representatives of interest groups (Renn, Webler, and Wiedemann 1995). Deciding whom to include or exclude emerges as a challenge for social scientists in general and in risk analysis in particular (Pidgeon 2021). While scholars have published much advice on what good participation looks like (Chess and Purcell 1999) the core challenge of how to balance demands of inclusiveness and representativeness in practice needs further research. In the next section, we will outline through different case studies how three European regulatory scientific agencies analyzed perceptions of risks associated with New Genomic Techniques (NGTs) to shed more light on this challenge.

Three case studies: approaches and results

NGTs have been framed by many as the source of fundamental changes in food and feed production. Considering the complexities, uncertainties and ambiguities associated with NGTs, scholars have demanded more holistic, including more deliberative, approaches to the analysis of their risk (Dryzek et al. 2020; Kuzma 2021; Weller, Govani, and Farooque 2021; Russell et al. 2022).

Within the wider European 'regulatory state' (Majone 1999) different regulatory agencies are involved in the analysis of risks associated with NGTs using a variety of methods to develop a better understanding of public perceptions and include public concerns in the drafting of regulations.

At European level, the European Food Safety Authority (EFSA) carries out a regular Eurobarometer Survey on food safety with randomly selected samples, with correction factors

applied (adjusting relative weights according to statistical representation) to ensure demographic and geographical representativeness across the EU. The Eurobarometer offers the chance to monitor awareness and concerns about different food safety topics among EU citizens, including use of new biotechnology in food production. Additionally, in 2021 EFSA applied a mix of social scientific methods (survey, social media listening exercises, and expert forum) focusing specifically on NGTs.

Similar developments can be found in many member states. In Germany, for example, the German Federal Institute for Risk Assessment (BfR) initiated a deliberative consensus conference on GE in the field of nutrition and human health in 2019. This accompanied focus group discussions and public surveys on the topic.

In the UK, the Food Standards Agency (FSA) has conducted research into consumer views of novel foods and novel food processes since 2019. Most recently, it has conducted deliberative research into consumer views on GE and precision breeding.

In the following, we will present these three cases in more detail and then discuss their implications for studying risk perceptions and enabling public engagement in risk analysis more widely. Comparative case studies as implemented here provide the opportunity to explore similarities, differences and distinct patterns, in this case across the different social scientific methods selected: surveys (EFSA, BfR, and FSA), consensus conferences and deliberative work-shops (BfR and FSA), focus groups (BfR), social media monitoring (EFSA) and online stakeholder engagement formats (EFSA).

Social media monitoring, stakeholder engagement and survey at European Union level (EFSA)

EFSA is the dedicated food safety agency of the European Union. EFSA has completed several risk assessments over the last few years on food and feed derived from biotechnologies as well as criteria for the risk assessment of NGTs¹, and in 2021, also started EU-wide social science research on NGTs. This was composed of three main activities: An online survey, social media monitoring, and a public engagement activity in the form of an expert forum. The survey encompassed representative samples of citizens for each country (total of 8,600 respondents from 24 EU countries, i.e. EU27 except Cyprus, Luxembourg, and Malta). Social media monitoring was done using the 'Pulsar' software and a keyword search using NGT-related terms (in English, French, German, Italian, and Spanish) across the EU27.

The survey revealed that awareness was low: Just over three in ten respondents had heard about NGTs before (36%), though awareness was higher among males (41% vs. 32% among females). Turning to social media, approximately 3.5 thousand Twitter posts were retrieved between January 2021 and October 2022. This is a relatively low number when benchmarked against food safety topics, such as alternative proteins or food contact materials (15.3 and 65.7 thousand posts, respectively, for a similar period). The low activity on NGTs in social media is in line with the low awareness among EU citizens revealed by the survey. Additionally, tweets from 137 institutional partners and stakeholders that are part of EFSA's NGTs ecosystem were analyzed. Between January 2021 and October 2022, there were 783 tweets and the tone of the discourse was moderately positive overall (+12 in a scale from -50 to +50 in Pulsar's 'sentiment score')².

In terms of knowledge, the survey showed that members of the general public lack knowledge or their knowledge diverges from what has been established in scientific studies. Notably, less than two in ten correctly indicated that not all NGTs require introducing a 'foreign' gene (15% vs. 38% incorrect) and close to half did not know the answer (47%). Importantly, research has shown that perception of naturalness is one of the factors influencing consumer acceptance of genetically modified (GM) foods, which is consistent with the finding that consumers tend to view cisgenic (adding only genes from the same species) more favorably than transgenic applications (adding 'foreign' genes) (Gaskell et al. 2011; Ufer, Ortega, and Wolf 2019). The survey also showed that respondents would like to know more about possible risks when it comes to NGT applications to agriculture and food production, with slightly over two thirds (69%) asking for more information (EFSA 2022)³.

The survey provided additional insights into the perception of plant-related applications: Around half of the respondents (52%) believed that NGT applications have a very or fairly positive effect overall (vs. 13% no effect and 35% very or fairly negative effect)⁴. Moreover, two thirds or more indicated that NGT applications will have a very or fairly positive effect on crop resistance to climate change (67%) and quantity of food produced (66%) (vs. 22% very or fairly negative effect in either case) (EFSA 2022)⁵.

Building on these findings and following publication of an updated EFSA opinion on the safety and the risk assessment of plants developed through cisgenesis and intragenesis, EFSA held a public engagement event in the form of an expert forum in December 2022. In alignment with the needs for more knowledge identified through the survey (i.e. 'what the possible risks are'), the expert forum focused on risk assessment and the scientific aspects of NGTs and was designed to bring together and promote an open dialogue between stakeholders with diverse expertise and views.

To promote openness, equality and inclusiveness, registration was open for all interested parties for around two months, and the event was publicized during biotech events and through a variety of EFSA's communication channels (Carrick et al. 2022).

The approach resulted in a diverse participant composition. There were 327 participants, representing 34 countries and different stakeholder categories: (1) Private sector, 36.4%; (2) EU national authorities, 16.8%; (3) Universities/public research institutes 15%; (4) EFSA staff, 7.5%; (5) NGOs, 6.4%; (6) EU institutions/agencies, 6.4%. Other participants included representatives from non-EU national authorities, EFSA panel members & networks, and international organizations. In selecting speakers, EFSA sought to represent a diverse set of relevant stakeholders following an earlier stakeholder mapping that the agency had carried out and the social media analysis.

An online tool (Sli.do) was used during the forum to gather questions and prioritize them for discussion based on intensity of agreement (i.e. highest voting). Participants also engaged in polls during the event. One poll indicated that 82% were familiar with the topic, which was also reflected by the answers given to questions collected through a separate pre-event questionnaire. Content analysis of these showed different interests across the stakeholder categories. Namely, private sector and international organizations were mainly interested in the ongoing developments on NGTs and their future regulation in the EU. The EU national authorities stressed their interest in risk assessment design, while aspects of traceability, detection methods, and socio-economic assessment were most often mentioned by non-EU national authorities. Queries from the universities/public research institutes mostly fell outside the EFSA remit, and included aspects such as improvement of societal trust in relation to NGTs, development of socio-economic risk assessment, and international trade; NGOs posed questions concerning risks e.g. unintended effects, impact on pollinators, and detection methods.

The online tool (Sli.do) allowed the audience to contribute to the discussion while ensuring transparency and managing power imbalances by reducing the chance of disproportionate participation by more active members or special-interest groups (Few, Brown, and Tompkins 2007). However, the method of self-recruitment poses its own challenges, e.g. lacking representativeness, as explained in section two. Focusing on professional experts and decision-makers rather than individual citizens can be justified since potential representatives of the general public lack general awareness and knowledge regarding the potential range of risks and benefits (Eaton et al. 2014). Looking ahead, extending engagement to an audience beyond experts and stakeholders, as well as examining whether all relevant groups within the wide spectrum of experts and stakeholders are involved, may help further promote inclusiveness and relevance of decision-making process, as well as contribute to generating wider legitimacy.

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In short, this research sheds light on information needs, acceptability and interests regarding NGTs, among others, thus providing insights to help guide decisions regarding communication, inform policy developments, and support broader engagement.

Focus groups, consensus conferences, and surveys in Germany (BfR)

The BfR serves as a regulatory scientific agency in the portfolio of the German Federal Ministry of Food and Agriculture. Its tasks include the assessment of health risks in the fields of food, chemicals and product safety, recommendations on risk reduction, and risk communication. It advises the federal government and informs the public about potential, identified and evaluated risks (BfR 2017). BfR conducts its own research, including social scientific research around risk perception and communication. On the topic of GE, BfR has applied a variety of methods.

In November 2016, it conducted four focus groups with 39 participants in total, considering criteria of gender (female/male) and age (20–40 and 41–60 years). Participants were recruited online and by telephone. An intermediate level of education was set as a condition for participation; most participants (85%) indicated a higher level of education⁶. Each focus group lasted 90 minutes and was moderated by an external professional. The discussions centered on knowledge, risk-benefit assessment, needs, demands, and acceptance (incl. consumer behavior).

Content analysis of all focus group discussions shows that most participants (87%) had heard of conventional genetic engineering, but hardly anyone was familiar with the new method of GE (5%). Most participants perceived GE as similar to conventional approaches. They rated food produced by either method as not natural. The lack of verifiability where GE had been applied to food items caused concern. Participants suggest that GE should be labelled in a transparent and comprehensible way. Regulators should be independent of industry or other financial and political interest. International cooperation was seen as important. The greatest benefit of GE was seen in the medical field, especially in the prevention of hereditary diseases. Overall, the method was more accepted than conventional genetic engineering but participants demanded information campaigns to open up an informed public discourse (BfR 2017).

To enable further citizen deliberation, understand perceptions and potential controversies, a consensus conference on GE in the field of nutrition and human health was organized in 2019 by a commissioned science communication agency. The event was advertised in public spaces, social and traditional media. Citizens with a good command of the German language and ability to attend three weekends could register. The event required no prior knowledge of the topic and excluded those with discernible vested and professional interest. A reimbursement (€500) for three weekends of participation aimed to provide access for all interested citizens. A total of 147 valid expressions of interest were registered. The applicants were divided into clusters according to socio-demographic criteria, including gender, age, and professional status. One applicant was randomly selected from each cluster, 20 in total.

Over the two preparatory weekends, the citizens discussed the scientific, economic and regulatory context surrounding GE. A scientific advisory panel composed of three professionals from technology assessment, risk management, and social research reviewed materials to provide balanced information. During a 3-day concluding conference, the group had the opportunity to ask questions to professional experts selected by the citizen group. A concluding document was presented to decision-makers from politics, governmental administration, science, industry and civil society at a final event. The professional expert hearing and final event were available on live-stream. Attendance at the event was open to the public subject to advance booking (BfR 2019a, 2019b, 2019c; Dendler 2022).

Participants decided to begin the concluding document with a disclaimer about the lack of consensus among individuals in the group. The group members acknowledged a wide range of potential benefits around health, climate, biodiversity or animal welfare as well as risks, such as decrease of species diversity or issues around patenting. Demands included funding for

independent research, no patent protection for living beings, choice for consumers and transparency, including labelling of GE foods, and a greater consideration of wider social and environmental issues, such as climate change, animal welfare or biodiversity (BfR 2019a, 2019b, 2019c).

An evaluation of the conference based on participant survey and interviews as well as participatory observations showed that while the event met many deliberative ideals, some participants tried to dominate the process. Others held back with their opinions. Overall, the method attracted mainly better educated, interested, and motivated individuals. Participants saw those with lower education or migration background excluded from the event and suggested random sampling from public databases as a potential solution. Some members of the organizing team objected to this suggestion and doubted that randomly selected citizens would be motivated enough to attend. The representative sample of willing citizens, as one participant termed it, demonstrated extraordinary motivation to engage with the topic and in discussions. However, many voiced concerns about the likely impact of such events. While most participants associated limited impact with difficulties in finding a consensus, a few felt that only a representative sample of the population would generate reasonable impact (Dendler 2022).

To gather representative insights, BfR included GE in its semi-annual population surveys on consumer risks (Consumer Monitor). Since 2014, 1,000 people have been approached twice a year by telephone interviews. The subjects are randomly selected from the German-speaking population aged 16 and over living in private households. If necessary, data are weighted by gender, education, age, employment, size of town, federal state and household size, based on population statistics. The survey starts with an open question about the issues that participants consider being the greatest health risks. Genetic engineering or genetic manipulation was among the most cited risks in 2015, 2016, and 2017, at 5%, 6%, and 7%, respectively. A closed question followed asking whether participants have heard of selected health and consumer topics, including GM food since 2017 and GE between 2017 and 2020. While GM foods were well known with an average of 92%, the topic of GE was rather unknown with an average of 14%. Participants were then asked whether they were concerned about each of the topics on the list, with GM food included since the beginning and GE again between 2017 and 2020. An average of 55% of participants voiced concern about GM foods and an average of 5% about GE. Due to continuous low awareness and new topics, GE was dropped from the list of probes in 2020⁷. Insights gained from all analysis have been used to inform policy makers, other stakeholders and the wider public.

Workshops and surveys in the United Kingdom (FSA)

The Food Standards Agency (FSA) has a legal responsibility for food safety in England, Wales and Northern Ireland. One of its stated principles⁸ is to use the in-depth understanding of consumer interests to inform decisions about the food system. In 2020 as the UK government was considering regulating GE food separately from genetically modified food, the FSA conducted deliberative research into consumer views on GE including awareness, levels of acceptability and concerns.

The study included 80 consumers across England, Wales and Northern Ireland, divided between four regional cohorts including North and South of England. Quotas were set for age, gender, ethnicity, socio-economic group (SEG), education level, rural or urban residence, food label literacy, and household make-up. Participants who were already potential experts were excluded from the research, including those working in agricultural settings, to ensure that workshops were not dominated by participants with strong prior views. Participants received £75 per workshop and £50 for participating in the online community.

Data on baseline awareness and preliminary views were elicited. Then, the first workshop provided essential information to enable consideration of the issue, including case studies explaining the differences between GE, GM, and traditional breeding. Independent experts were

invited to the sessions to answer questions. This allowed participants to build their knowledge, form their own position, and ask further questions.

The first and second workshop was bridged by an online community exercise lasting two weeks, with opportunities for participants to ask further questions to the experts. Participants reviewed newspaper articles and food labels in their cupboards as an introduction to the next workshop. They took part in a quiz to test and improve their understanding from the first workshop and to ensure they understood the difference between GE, GM and traditional breeding. The final workshop explored consumer concerns, levels of acceptability and the reasons for the participants' judgments as well as opinions on regulation and labelling. Food items mocked up with GE labelling were sent to participants and used as prompts for conversations both on how information could be presented and whether participants were willing to consume GE foods.

To test the results obtained from this qualitative research at a wider population level, a survey of 2,000 participants in England, Wales and Northern Ireland followed. The survey sample was weighted by age, gender, and region and working status to ensure that it was broadly representative of citizens engaged online between the ages of 16–75. It found that awareness of GE was low. Around 20% of participants in the survey said they felt informed about GE; however it was clear that even amongst these participants there was confusion in the distinction between GE and GM. Only 27% of participants thought that GE was acceptable in animals, a larger percentage of 49% in plants. 37% of participants thought that GE foods should not be up for sale, 32% thought that they should, while 31% did not know. There was near consensus on the need for labelling with 85% of participants believing GE food should be labelled. Key concerns related to uncertainty about the long-term impacts of GE on human health. Generally, respondents were happy with the idea that GE would be regulated separately from GM, but because of this felt, that regulation should be as strict for GE as for GM. Other frequently cited concerns were the impact on animal welfare, the consequences for the environment, the implications on costs of foods and the compatibility with sustainability.

In August 2022 the FSA undertook follow-up research on consumer views of precision bred food, working to a tight timescale as the Genetic Technologies (Precision Breeding) Bill was going through parliament in the UK, including a change of policy terminology from 'gene edited' to 'precision bred' foods. The method was similar to the 2021 GE study, however, this time the quantitative survey preceded the application of the qualitative methods and had a sample size of over 4000, boosting the sample in Wales and Northern Ireland, and including Scotland, allowing for a comparative analysis between the four nations of the UK.

Then, similar workshops were conducted, however, external experts did not attend and there was no online community due to time constraints. As before, the study did not include those who were already experts. Workshops allowed for six hours of discussion across the two sessions. The sample comprised 97 participants, with 43 in England, 26 in Wales and 28 in Northern Ireland⁹. To ensure that the workshops delivered a diverse range of views and experiences, each workshop sample met minimum quotas on age, gender, ethnicity, and socio-economic composition as well as household composition, dietary habits and food hypersensitivities. Participants received £120 in total for their time (£60 per 3-hour workshop). Again, the first session focused on information provision with more detailed discussion on information needs and regulation in the second. The report will be published in early 2023, but initial findings are similar to the 2021 study¹⁰, though interestingly the change of nomenclature from GE to PB seems to influence higher consumer acceptance of the technology. The findings will provide policy makers with an understanding of consumers' information needs and their preferences of how they would like precision bred food to be regulated.

While there are certain caveats about using digital deliberation, particularly around accessibility to those less digitally literate, the researchers made efforts for the workshops to be inclusive. There is anecdotal evidence that an online workshop is less likely to be dominated by the more confident participant, however, you are less likely to get the to-and-fro of debate. People also found it easier to take part from home than to find a whole day around work and caring responsibilities (regardless of financial incentive). This might have made it easier for younger and busier people to take part. The sample was chosen to reflect awareness and attitudes among the general population as revealed by the survey rather than the views of those more invested. By doing this, it might miss those with stronger feelings and vested interests, and thus miss the opportunity to discover stronger objections which might influence the public discourse.

Discussion

In the following, we will discuss the results concerning the context of GE and social scientific perception research more widely. On a contextual level, the cases point to limited knowledge of NGTs across wide parts of the general population. There are some differences according to gender (e.g. higher awareness and acceptance among males). Across cases, there was a widespread demand for information, as well as requests to align developments with wider social and environmental goals. German and UK participants requested labelling to promote transparency and freedom of choice for consumers. Application in the area of plants and human health finds more acceptance than for farm animals. Prominent concerns regarding NGTs include unintended side-effects and impacts on human health, as well as wider social and environmental implications. A high degree of unfamiliarity with GE compared to GM was observed in the UK study, which was also echoed in the two other studies. This might explain overall knowledge divergences and suggest that survey respondents may not be able to identify their concerns about risks due to lack of familiarity with the issue. Concerning dominant demands for product labeling, feasibility poses challenges. Moreover, the wider social scientific literature reminds of the need to distinguish between verbalized demands and practiced consumption behavior, with the latter tending to be routinized and embedded in larger social structures rather than being purely guided by information (Upham, Dendler, and Bleda 2011: Dendler 2014).

On a methodological level, the cases confirm the well-established limitation of analytic methods, in particular surveys, to shed light on perceptions when applied to unfamiliar topics. The tendency to look at averages and means in representative samples often obscure the variations between different groups and make it difficult to grasp social plurality. Methods that provide a one-shot measurement of preferences and viewpoints, leave no room for participants to learn from each other and from external sources—a problem especially for unfamiliar topics. However, if properly conducted, they can provide an overview of viewpoints, preferences and concerns, and intuitive evaluations distributed within a defined population. Furthermore, they may be supported by qualitative methods that provide a more in-depth representation of individual or social contexts.

The focus group and deliberative events conducted indicate a higher degree of public engagement. These experiences provide room to listen to citizens' experiences and concerns, as well as promote dialogue and group discussion, going beyond analytic research methods that consider the public as a passive actor. Focus group discussions as well as consensus conferences offer a space for citizens to talk in-depth about a specific topic. Such a discursive approach is particularly valuable when participants share a low familiarity with the topic. However, these methods tend to be resource intense, especially if there is a need for familiarization with a new and complex topic.

There are additional challenges associated with deliberative methods that were apparent in the three case studies. The selection of participants provides a first dilemma: if the sample is too homogeneous the criteria of inclusiveness and representativeness are likely to be violated; if the sample is too heterogeneous it is very likely that the group will not reach any closure (Renn and Schweizer 2020, 2009; Dendler 2022). The second major drawback is the limitation of group size. An engaging and constructive deliberation demands a small group composition, which in turn limits the opportunity to have a statistically representative sample of the targeted population (Lafont 2015). This limit can only be overcome by combining different formats: in the UK case study, the physical group meetings were supplemented with a larger participatory involvement of consumers in online discussions. A third limitation refers to the inclusion of marginalized groups. The deliberative methods used in the UK and German case study made an effort to promote representativeness and inclusiveness both in selecting participants and in designing the formats. Random selection as adjusting for gender and age was used to provide a large degree of heterogeneity but also of a rough representation for the targeted public(s). Diversity was emphasized in the UK workshops that included individuals with different ethnicity and low technical knowledge. However, in both German and UK cases, there was no claim of representativeness in the statistical sense nor in the deliberative ideal of having all relevant arguments represented (Renn and Schweizer 2020). Despite measures to promote inclusive access, such as plural recruitment criteria, reimbursement benefits or previous provision of information, formats struggle to include individuals with lower education or migration background, for example. This inability to reach out to the full scale of groups provides critics of these formats a convenient argument to discredit them. Future study on the extent to which activities, such as reimbursement or pre-information, may affect the inclusion of participants with less resources or motivation are needed.

Ensuring inclusiveness through engagement of stakeholders is another prominent route in the context of emerging technologies (Bell, Morse, and Shah 2012). The expert forums on the European Union level involved many professional actors in a dialogue format. The self-selection as a recruitment method, followed by the high degree of familiarity with the topic and the different proportional representation of stakeholders poses a challenge if this format is used in isolation. Yet, when coupled with more participatory formats it may provide a larger and more inclusive picture about the positions and viewpoints of all relevant actors in society. Extending engagement to stakeholder and the public by using the appropriate formats can help to promote inclusiveness, to increase the relevance for the decision-making process, and to contribute to generating wider legitimacy.

However, even when people are included formally, structural inequalities and power asymmetries can affect group dynamics throughout the events. New online tools can help address some of these issues. One needs to remain attentive, though, to the new and remaining challenges of online services, such as unequally distributed software capabilities, inherent inequalities in the production of (dominant) knowledge or issues of digital incivility and polarization (Dendler 2022; Webler and Tuler 2021; Ruggiero and Vos 2014; Anderson et al. 2017). While already a popular research field, further studies on how to manage power dynamics and avoid the marginalization of voices both on- and offline remains an important area for further research.

In essence, the case studies showed that one single format is not sufficient to meet the criteria of inclusiveness and representativeness. It is too early to conclude what combinations may be most instrumental in meeting these criteria. The combination of analytic approaches with different deliberative and other participatory methods, including physical and online, seemed to be best suited for the envisioned purpose.

Conclusions

Risk analysis involves different levels of interactive exchange: (1) exchanging information about risks with consumers or other affected groups; (2) the dialogue within and between risk assessment and risk management; and (3) engagement of all parties affected by risk analysis outcomes (EFSA 2021). Social science plays a key role in all these processes.

This article demonstrates that the choice of research methods and formats plays an important role in how social science can execute this role and help to understand risk perceptions. The cases indicate that only combinations of methods and formats are able to simultaneously approach the criteria of inclusiveness and representativeness. In particular, the integration of analytic and participatory methods provides a more inclusive picture of both social robustness of different arguments and proportional distribution of attitudes, preferences and viewpoints in the targeted population. Such a combination could include surveys (enriched with qualitative in-depth studies) and participatory formats that promote mutual learning. The deliberative methods applied in the case studies succeeded in producing valuable insights into risk perceptions and supporting public engagement in the process of understanding risks and articulating recommendations for regulations. However, all methods struggled with the inclusion of individuals of marginalized groups. There is an urgent need to understand the mutual constructions of risk and structural inequalities.

Notes

- 1. EFSA (2022, December 12). Stakeholder Event on 'The safety of plants derived from New Genomic Techniques: looking into future risk assessment challenges'. EFSA, https://www.efsa.europa.eu/en/events/stakeholder-event-safety-plants-derived-new-genomic-techniques-looking-future-risk
- 2. The 'sentiment score' measures the positive, negative, or neutral opinions about the topic by looking for words that carry an explicit positive or negative meaning. Although the analysis considers qualifiers (e.g. really good vs. good distinction), it doesn't capture sarcasm, irony or slang which is an inherent limitation that can introduce some noise in the data.
- 3. Interest was lower for other issues, namely knowing who will benefit and who will bear the risks, what is being done to regulate NGTs, what the benefits are, or whether consumer will be given a choice about whether to buy these products or not (42% to 38% of respondents). At the bottom, were knowing who is funding the research and why (23%) or which actions are being taken to deal with social and ethical issues (18%).
- 4. In the second half of 2021, the European Commission started an initiative to propose a legal framework for plants obtained by targeted mutagenesis and cisgenesis and for their food and feed products. https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13119-Legislation-for-plants-produced-by-cer tain-new-genomic-techniques_en
- 5. Around half considered this to be the case for environmental sustainability (52% positive vs. 36% negative), and food safety (48% positive vs. 39% negative). By contrast, views were more split for applications to food taste (43% positive vs. 37% negative) or human health (42% positive vs. 43% negative perceived effects).
- 6. Intermediate level of education implies German "Realschulabschluss (Mittlere Reife) or "Abschluss der Polytechnischen Oberschule (10.Grade)". Higher level of education means "Allgemeine oder fachgebundene Hochschul-reife/Abitur, EOS, oder Fachhochschulreife Fach-/Hochschulstudium".
- 7. https://www.bfr.bund.de/en/publication/bfr_consumer_monitor-195708.html
- 8. https://www.food.gov.uk/about-us/our-guiding-principles
- 9. Scotland did not take part in the qualitative work as it will conduct its own qualitative research.
- 10. https://www.food.gov.uk/research/behaviour-and-perception/consumer-perceptions-of-genome-edited-food

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