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CONFERENCE ARTICLE

Communicating to and engaging with the public in regulatory science*

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Abstract

This paper presents selected highlights from the 'Engaging with society' session of EFSA's third Scientific Conference 'Science, Food and Society' (Parma, Italy, 18–21 September 2018). The social dimension for scientific advisory bodies largely concerns science communication and public engagement. The political, economic and technological transformation of contemporary societies is challenging conventional structures and approaches in these areas. The disintermediation of communication and the proliferation of misinformation, it is argued, herald the onset of the post-truth society. A better understanding of the way individuals consume information today has led to the development of tools to guide mediators such as journalists and communication specialists in countering these trends. Public engagement can reinforce confidence in regulatory bodies and potentially contribute to the quality of the scientific process. Scientific advisory bodies in Europe have created strategies and mechanisms to engage the public that are designed to increase transparency and representativeness. To be effective, several engagement mechanisms are needed, although factors such as resource constraints, institutional culture and public/ stakeholder attitudes may limit their development. In conclusion, a more vigorous role for social research is needed to place scientific risk assessment within broader socio-economic and political contexts. Social science expertise can help to define more impactful public information strategies and to explore the potential opportunities that engaged stakeholders and citizens can make to sustain and strengthen regulatory science.

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* Anthony Smith and Lucia Parrino have contributed equally to the work on this paper and should be considered co-first authors.

The EFSA Journal is a publication of the European Food Safety Authority, an agency of the European Union.

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1. Introduction

For scientific advisory bodies such as the European Food Safety Authority (EFSA), the societal context concerns both the role of science communication in delivering coherent information targeted at specific audiences, and characterising engagement opportunities that not only increase confidence in their scientific advice but also contribute to the quality of their science.

In a first for the EFSA, its 'EFSA Conference 2018 – Science, Food, and Society' sought to facilitate debate on the social dimension of food safety as well as the state of scientific risk assessment in food safety. The opening session 'Where science meets society: putting risk assessment in context' made that abundantly clear, reinforced by keynote speeches on 'science meeting society', 'communication of uncertainty' and on 'communication challenges of the future' in the final closing session (Devos et al., 2019).

The conference included a one-day session on 'Engaging with society', which probed the communication and engagement facets of the regulatory science environment. It examined how the conventional structures and approaches in these realms are being challenged and put under strain by recent bursts of political, economic and technological change that are transforming contemporary societies. These include, for example, consideration of how the explosion of social media use is disintermediating communication, i.e. cutting out the middleman, or how the proliferation of misinformation and fake news has led to assertions that society has entered a post-truth phase. The contribution of the social sciences – in disciplines such as sociology, social psychology, behavioural sciences and communication sciences – will be crucial in this context. For science-based organisations, evidence-based solutions are non-negotiable. Therefore, social research must form the basis for understanding today's challenges, and for developing solutions and exploring potential opportunities that engaged stakeholders and citizens can make to sustain and strengthen regulatory science.

This publication, therefore, builds upon the presentations made and discussions held during the break-out session 'Engaging with society' at EFSA's third Scientific Conference 'Science, Food and Society' (Parma, Italy, 18–21 September 2018).[1] The paper examines the main ideas and discussions that emanated from the 'Engaging with society' session, organised in two main sections dealing, respectively, with 'communicating regulatory science in today's information ecosystem' and 'public engagement in regulatory science'. Our conclusion draws on the outcome of the session's two panel discussions, where the participants supported a more active role for social science expertise and research in placing scientific risk assessment within the broader socio-economic and political contexts.

2. Communicating regulatory science in today's information ecosystem

2.1. Reporting on science: mediators and journalism

Science communication is as old as science itself. Traditional science communication has been depicted as a hierarchical and sequential continuum of stages: intraspecialist, interspecialist, pedagogical and popular. Barriers to understanding and accepting new scientific results and theories among these audiences remain the same as 100 years ago, i.e. entrenched views, cognitive biases, technical literacy and numeracy. Intraspecialist communication involves debates among the leading minds, the custodians of accepted theories on one side and their challengers on the other. Interspecialist exchange spreads new and emerging concepts as agreement takes hold (e.g. through journals). In the pedagogical mode, communication takes the form of text books and lectures in support of instruction and learning. In the popular sphere, books, news media and television are leading sources of public information.

Mediators were traditionally conceived as professionals capable of explaining complex scientific ideas to the public, and as such were the cornerstones of Science Communication 1.0 for most of the 20th century. They were the crucial protagonists in managing the discourse, devising the working practices and communications channels that also created their knowledge value, cemented their positions of influence and formed the basis of their economic sustainability. They mediated and filtered. New patterns of interaction, however, have decentralised information since the 1980s, transforming this model, and posing a series of challenges to the mediators, the tools and channels they use and their authority as expert storytellers and opinion formers. Technological advances have both broadened the possibilities for communication and narrowed the economic sustainability of traditional mediators such as journalists. Also, since the new Science Communication 2.0 is horizontal

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[1] All conference materials are available at https://www.efsa.europa.eu/en/events/event/180918

and open, traditional mechanisms that rely on the reputation of the channel (e.g. national television channels, science museums, quality newspapers) are no longer available to users of information. In today's hyperconnected world, the internet is the medium between our civic and daily lives, but new media are 'disintermediated' (i.e. the role of the mediator has drastically decreased or disappeared) and continuously changing. Besides technological change, there has been a marketisation of science through the third mission push defined in the European Charter for Researchers, whereby it has been the duty of scientists since the 1980s to disseminate and discuss their scientific results with the public through, for example blogs, websites, games, interviews and, more recently, Twitter (Bucchi, 2018). But does this promote science or serve public relations purposes? Has it led to unforeseen consequences such as the public airing of the 'backstage of science' (i.e. divergences) and consequently the explosion of fake news? Do people really understand or have the means to use the information about science that they receive?

Despite this disintermediated context, research by the 'Science and Society Monitor' (Bucchi and Sarracino, 2018) indicates that one in three members of the public consider journalists, i.e. the traditional mediators, to be the main purveyors of misinformation about science and technology or medical/public health-related issues. By comparison, 25% of respondents consider those who share fake news mainly responsible, followed by 20% for Facebook and other social platforms. Although social amplification (Pidgeon et al., 2003) and storytelling are realistic approaches to attenuation of risk, the role of the traditional mediators is still needed or communication about the science of such issues will continue to be problematic as, for example, in the cases of the Brent Spar accident (Löfstedt and Renn, 1997) and pesticides use in agriculture (Löfstedt, 2018).

Structures to facilitate and encourage evidence-based mediation approaches in science communication are a part of this. The Science Media Centres in the UK, Australia and other countries are conspicuous examples, leading to not only positive assessments – more accurate science communication by journalists – but also some allegations of overselling science for public relations purposes.

A George Institute for Public Health research project was designed to develop and test a methodology and practical toolkit to use with local journalists in India to counter misinformation and encourage more accurate and balanced communication on public health issues. The study combined desk research and interviews to understand the dynamics that influence Indian journalists, critically analysing 350 media stories on India's routine immunisation programme introduced in 2014, and scoring them by means of a 10-point checklist (called 'media doctor') for accuracy, balance and completeness. Using the tool identified gaps in the reporting and skills/knowledge base of these journalists, findings which were used to inform one-on-one discussions with journalists aimed at retrieving additional information and insights. The research findings indicated structural issues in the journalists' working methods, i.e. few stories were based on two or more sources (46% on one source only), there was an over-reliance on government sources and a lack of sufficient expertise (e.g. low technical literacy, lack of understanding of different perspectives in public health) to critically challenge those sources or independently verify them. These factors contributed to reporting being episodic rather than contextual. Patterns derived from the interview responses indicated non-enabling factors that sustained the dysfunctions of this model: low priority given to public health issues by media, lack of career opportunities for journalists in reporting health issues, editors' inability to differentiate health news from other news, economic incentives to sensationalise news, time pressures on newsrooms and their gradual homogenisation as generalists rather than specialists. The personal circumstances or beliefs derived from the economic, social, religious and political orientations of the journalists also played a part.

Journalists helped to identify the knowledge and skills they considered were needed to alter and improve these working practices, e.g. being able to locate and analyse data effectively, frame health stories with relevant context, understand conflicts of interest and report on health through the lens of risk. The Critical Appraisal Skills Programme (CASP) approach provided the basic methodological framework for piloting support to some 100 journalists in their reading and use of scientific information. CASP principles were tailored to individual needs (based on the empirical findings) and to the national, cultural and public health context in India. Through training and support, journalists recognised the alignment of evidence-based approaches to the basic three-step newsroom model: news gathering as problem formulation and identification of evidence needs; news writing by promoting balanced reporting, differentiating between correlation and causation, the investigative processes akin to experimental science; and news editing by rationally describing and contextualising. The suggested approach has three levels of engagement: formative to understand local contexts and

factors deriving from the relationship between belief systems and critical thinking; use of evidence in correctly analysing and presenting scientific data; and contextual in understanding the influence of social, political and cultural factors used in the formative and evidence steps. It was concluded that 'a critical finding was that the information-deficit model has to be complemented by a model that combines critical thinking and analysis, understanding science and taking an evidence-based approach' (Krishnaswamy, 2018).

Through such initiatives, mediators can be assisted in developing the required skills to evaluate the quality of media reports and to read research papers, discouraging single source reporting. CASP principles can contribute to this, but a broader-based approach would be needed, for instance to also address the role of professional science communicators employed by public authorities, e.g. press officers, public information specialists. The Clear Communication Index developed by the US Centers for Disease Control and Prevention (CDC) provides such a model and has been previously analysed by EFSA for its applicability in relation to food safety in Europe (ICF et al., 2018). An evidence-based tool for food safety could be achieved by adapting the media doctor tool (which was developed for the technology sector but, as this study shows, is adaptable to public health), providing journalists with a reliable feedback mechanism (e.g. Science Media Centres) and replication in different geographical/ national contexts.

2.2.   Scientific debates 2.0: biases, social media and trust

Public debates are shifting the communication and engagement models used by regulatory science, such that it is increasingly aiming to deliver its findings in a way that meets the expectations and needs of society. Analyses of risk perceptions, coupled with understanding of the complex system which facilitate the debates of today, are becoming the focus of social research undertaken by regulatory bodies.

Different people perceive different risks in different ways (Slovic, 1987). This is because awareness or knowledge about a specific risk interacts with psychological, social or cultural factors that can amplify or attenuate the actual perceptions of risk (Pidgeon et al., 2003). Therefore, to deliver a message that will both accurately reflect the findings of science and meet the information needs of the public, risk communication has the task of understanding how people form opinions based on the perceived risk levels.

A common assumption, based on a so-called 'information model', is that people seek as much information as possible to interpret a risk. This is often coupled with a view that more knowledge, for example on new technologies, implies approval, or that awareness or education leads to a change in behaviour. These assumptions, however, may not hold true in today's information ecosystem (Thaler, 2016). In fact, the proliferation of information sources and the rise of disintermediated media have resulted in information overload owing to limited cognitive bandwidth, leading individuals to control their attention span and aim to reach a decision as quickly as possible with the minimum required amount of supporting evidence. This often includes use of heuristics, and is influenced by the context in which we receive information such as the time of day, place, online information vs. face-to-face, etc. Our experiences build perception biases that in turn play a key role in defining our risk attitude. The described features of an empirically-based model differ substantially from the simple information-seeking approach.

This fast and intuitive decision-making system (Kahneman, 2011) has not informed regulatory risk communication sufficiently in the past. Indeed, official institutional communication has largely relied on the assumption of a slow and reflective decision-making process, often using technical scientific language inaccessible to the wider public. While such an approach provides extensive information, it ignores the aforementioned limited cognitive bandwidth and can increase confusion rather than meet the target audience needs.

Communicating complex scientific topics requires contextualisation. Taking uncertainty in risk assessment as an example, non-contextualised communication may easily result in loss of confidence in science. Yet, being transparent about scientists' confidence in their conclusions and using comprehensible language to explain their uncertainty provide for a more informed debate, whether an audience has a scientific background or not. EFSA's recent 'Guidance on communication of uncertainties in scientific assessments' (EFSA, 2019) attempts to provide a more structured approach for tailoring information on uncertainties in food safety assessments to diverse audiences across Europe. Further research is required to examine the understanding of the uncertainty information and whether various communications formats result in different decisions.

Besides context, another important consideration concerns the propensity of individuals to form opinions in groups, catalysed through technological changes. The prospect of sharing similar opinions, regardless of physical remoteness, is a major factor influencing global communication. In a hyperconnected world, a reliance on the internet and social media in civic and daily life is shifting the centre of public debate to the online sphere.

Limited attention, coupled with competing information, often results in rapid interpretation and shortcuts to taking decisions. One of these shortcuts is to interpret information in a way that is already coherent with our system of beliefs and conforms to dialogue with like-minded individuals who share our opinion. This confirmation bias is a common phenomenon that can result in reinforcement of shared views and, ultimately, a more extreme position on a specific topic (Sunstein, 2002). The analysis of digital traces of users behaving in such a way has provided evidence of the existence of 'echo chambers' (Del Vicario et al., 2016) – online spaces characterised by interaction with information aligned to specific views on a given topic.

Studies have shown strong polarisation within both science and pseudo-science echo-chambers on Facebook (Del Vicario et al., 2016) with users of opposing views rarely interacting. Exposing these users to information that discredits pseudo-science claims and portrays them as exaggerated or false (debunking) has proven to have mixed results between the two groups (Zollo et al., 2017). Users from scientific echo-chambers interact with debunking information as it is aligned with their views. On the contrary, users from the pseudo-science spheres rarely interact with the information and, when they do so, use it to reinforce their argument. In the latter case, the debunking process arouses a backfire effect, suggesting it is an ineffective tool for communicating science.

The question is: 'What can regulatory institutions do to tailor their risk communication to the modern information ecosystem?' Any action proposed to make communication more effective should be based on an understanding of the way citizens form opinions and consume public information, and implemented with a view to increasing accountability and trustworthiness. Research suggests that high levels of public trust can equal low levels of perceived risk, and vice-versa: 'trust explains up to 50 percent of how the public will perceive a certain risk' (Löfstedt, 2004). In the risk analysis process, engaging with actors from civil society such as consumer organisations increases understanding of stakeholder expectations and concerns regarding the work of regulatory bodies. Definitions, objectives and approaches to public engagement in regulatory science are described in the following section of this paper.

In the area of food-related risks, the most recent pan-European research on public awareness, perception and expectations was conducted in 2010. This is a crucial gap to be filled, particularly considering the socio-political and technological changes influencing consumer preferences and behaviour in the past ten years. EFSA committed to take this recommendation on board and for new research to form part of its plans for using social science. The findings would inform risk communication and help to contextualise risk assessment by EFSA as well as other authorities and EFSA's partners working in food safety across the European Union (EU).

How risks are communicated remains a key consideration. Recommendations to improve messaging call for easy-to-understand, timely and meaningful information, disseminated jointly with trustworthy actors from civil society. A recent research study commissioned by EFSA on awareness and understanding of chemical mixtures found that simple language, highlighting the independence of scientists and steps taken to avoid conflicts of interest in risk assessment, increases confidence in scientific advice (ICF et al., 2019). Visually appealing communication and use of infographics were found to provide additional clarity when communicating complex information.

From an organisational point of view, periodic use of independent evaluators to provide an impartial assessment of the scientific process helps strengthen the accountability of regulatory bodies. Also, having a head of communication/engagement within the authority's high-level operational management places interaction with society at the heart of the decision-making agenda. Independent social science advisory boards or working groups of experts can provide further advice on how to communicate science in clearer, more accessible ways to meet the information needs of targeted audiences.

In the wake of challenges in coherently explaining the risk assessment of the pesticide active substance glyphosate, EU policy incorporated recommendations to improve the effectiveness of science communication. The recently approved revision of Regulation 178/2002 – also called the General Food Law, the regulation that established the current EU food safety system and created EFSA in 2002 – renewed calls for taking risk perceptions of all interested parties into account as part of the general principles of risk communication. This development paves the way for EFSA and other institutions to

optimise the use of social research to inform and drive forward the way they approach today's information ecosystem.

3. Public engagement in regulatory science

3.1. Objectives and approaches

In the context of contemporary science, the number of places, actors and institutions linked to the production and use of techno-scientific knowledge has increased, spreading outside traditional research settings. Nowadays, the actors contributing to the development and sharing of such knowledge are manifold, ranging from academia to governmental institutions, industry, civil society organisations and public–private hybrid bodies (Castelfranchi and Pitrelli, 2007). Also, because of the above-mentioned changes in the communications landscape, epistemological, political and socio-economic debates that once were internal to the scientific community and policymakers have now entered the public sphere. Science is developed, debated, negotiated and used by different social actors, who may be lay or expert, depending on the situation. Decision-making on and within regulatory science is shaped by interactions – sometimes conflicting – within 'network-like constellations' (Felt and Fochler, 2010, p. 220) of different actors (public bodies, industry, civil society, citizens, etc.) with different objectives, languages, values and expertise (Jasanoff, 1995; Castelfranchi and Pitrelli, 2007).

This provides the context for what has been called the 'participatory turn' (Felt and Fochler, 2010, p. 220) in managing science–society relations, resulting in a growing interest towards public engagement as a means to incorporate meaningful public input and societal values and perspectives into science and technology developments and related policy-making. Among the reported – but not always assessed – benefits of this participatory involvement of societal actors are that 'trust in policy makers may be regained; political efficacy may be acquired; democracy may be enhanced; disputation may decline; and policy decisions may be improved [...]' (Walls et al., 2011, p. 242).

The reasons for participatory engagement found in literature may be linked to three dimensions:

- normative–democratic – participation is the right thing to do according to democratic principles,
- instrumental – participation improves and facilitates decision-making,
- substantial – participation improves the quality of decisions by increasing the breath of available information and perspectives.

The value and consequences of public engagement translate into public empowerment and democratic accountability. The importance of engaging citizens in monitoring and assessing techno-scientific research and related policies includes providing them not only with open data and facts, but also with the tools, knowledge and spaces to ask questions and make sense of those data and facts.

Supported by legislative frameworks and institutional endorsement, and sustained by the work of researchers and practitioners in the field, a growing number and variety of public engagement mechanisms have been developed and tested to allow effective public and stakeholder engagement, ranging from those surveying and eliciting opinions (e.g. survey-based public consultations, hearings) to more interactive, dialogue- and deliberation-based, activities (e.g. consensus conferences, citizen juries). Significant effort is being devoted to categorising and defining engagement approaches and mechanisms, with the aim of better understanding and addressing their effectiveness against target audiences and objectives (e.g. Rowe and Frewer, 2005). A number of toolkits and catalogues have been published with the aim of enabling researchers, policymakers and other interested organisations to identify the most appropriate tools (e.g. the Action Catalogue developed in the context of the Engage2020 project funded by the European Commission) (Engage2020, 2015). This shows how at both the theoretical and the practical levels there is a strong interest towards developing, testing and assessing methods and tools for citizen and stakeholder engagement. This applies also to the area of regulatory science, as shown by the experiences discussed during the session and presented below.

The cases can be grouped into two categories that describe the kind of participatory approaches adopted by regulatory institutions:

- institutional involvement – e.g. accreditation system for stakeholders, stakeholder forums or committees within the organisation, participation of stakeholders in management boards;
- substantive involvement – e.g. exchange of information, public hearings, consultation and feedback.

The variety of tools, processes and policies adopted by the institutions presented here are indicative of their commitment in identifying the most appropriate mechanisms according to their different objectives and target audiences. A recurring theme throughout the session was the impossibility of imposing one-size-fits-all solutions on the actors involved and the formats to be used. Multiple factors need to be considered when planning for public engagement in regulatory science, such as the subject and aim of the engagement practice; the stage of the risk assessment process to which it is linked; and the different stakes the various actors have in the subject. As was stated (Brown, 2018):

'... it wouldn't be the same from issue A to B. And to have a pre-formed idea of whom you should consult and how in every case is an abdication of responsibility, in fact ... As a public engagement approach, you need to have judgement ... There will not be a formula that will protect you for every scenario. You have to accept making judgements and responding to the needs of the situation, and then be held to account for it. That is the nature of public engagement'.

In this respect, we summarise below four critical points that emerged from the discussions held during the session as relevant to inform appropriate engagement strategies.

- Context awareness

Engaging with society is fundamental to understanding the context in which the institutions are operating and their position: e.g. the expectations they are subject to; the topics they need to engage on; dominant worldviews; existing networks of power and influence as well as potential crisis events that may change them (Dendler and Böl, in review). Early and strategic engagement is important in developing a sense of the context that is not influenced exclusively by self-appointed advocates of one view who are independently motivated to interact with a given institution.

- Representativeness

Representativeness – which is linked to contextual awareness – can be considered at two levels. The first concerns the need for balanced representation of all the constituencies with a stake in the subject of the engagement for it to be considered appropriate and effective. The second is on the extent to which the stakeholder organisations engaged in institutional activities can be considered as representatives of their constituent parts or of the public at large. These issues have been addressed in some literature on public engagement and citizen participation (Felt and Fochler, 2010; Parvin, 2018). One should caution, however, against considering representativeness and visibility in the media as systematically linked, given some organisations might have more access to media coverage than others, regardless of their representativeness. Among the results of a recent study on public participation and stakeholder management conducted by the German Federal Institute for Risk Assessment, some interviewees criticised the mediated involvement of the general public through dialogue with identified associations as they didn't feel the public to be represented by those organisations (Dendler and Böl, in review).

Typically, dialogue-based engagement activities developed by regulatory bodies are intended for stakeholder organisations, while interaction with the general public has been conducted mainly at the level of information campaigns, survey-based consultation, and research (mostly with quantitative methods) on public perceptions, concerns and attitudes. Engaging directly with the general public, according to more interactive, dialogue-based approaches, implies envisioning and developing methods and addressing challenges different from those experienced when working with stakeholder organisations.

- Transparency

Transparency relates also to the methodological choices shaping stakeholder and public engagement throughout the risk assessment process, e.g. which actors have been involved, why and how; and how their views have been taken into account, and what influence they had on the process. Clarity and transparency on these methodological aspects are important in ensuring balance between public engagement and scientific independence, and in enhancing the trustworthiness of the process and related decision-making.

- Systemic attitude

Traditionally, engagement activities have been designed and developed within communication departments. Nevertheless, as shown by the cases discussed, to engage effectively with society throughout the risk assessment and communication process, it is fundamental to have the right mindset and attitude systemically embedded across the whole organisation. The need for a systemic approach applies also at the interinstitutional level, albeit this was less explored by the regulatory bodies presenting their experiences during the session. The feasibility and effectiveness of having joint engagement and communication from different bodies in charge of assessing and advising on different aspects of highly complex problems needs to be further implemented and investigated.

3.2. Lessons from regulatory bodies

3.2.1. Targeted approaches and tools for public engagement

The European and national regulatory agencies taking part in the session have developed dedicated programmes for targeting, involving and generating contributions from stakeholders that aim to strengthen public confidence in their systems and work towards consensus-building on issues of conflicting interests in relation to their work.

The French Agency for Food, Environmental and Occupational Health and Safety (ANSES) has a wide remit covering an array of sensitive issues that require detailed understanding and categorisation of stakeholders and their interests. However, for practical purposes, the unit working on social sciences, expertise and society targets priority groups of stakeholders: citizen non-governmental organisation's NGOs, professional organisations and trade/agricultural unions. They are identified through 'societal watch' monitoring, which helps to discover emerging stakeholders as well as the priorities of established opinion-formers. Stakeholders are involved at various levels: governance, dialogue committees, as well as through hearings held during the risk-assessment process.

The European Medicines Agency's (EMA's) stakeholder involvement stretches back to its founding in the early 1990s and was most recently updated in its 2016 'Stakeholder Relation Management Framework'. EMA's key stakeholders are clustered in groups of patients, consumers and health professionals. Working parties representing these groups are consulted by EMA in a structured and consistent manner during the presubmission, evaluation and postauthorisation phases of the agency's work cycle. A range of support tools and resources are provided to sustain the working party groupings: annual training days, dedicated webpages, one-to-one personalised support, videos and info sheets. But one size does not fit all, so a variety of engagement tools are needed to activate different stakeholders, including surveys, conference calls, committee meetings, public hearings and elicitations.

These examples underline the relative effectiveness of regulatory bodies at dealing with organised stakeholder groups. However, the panacea for many regulatory bodies is to engage directly with citizens. Too often, however, this is considered by those same bodies to be too challenging or unrealistic for a variety of reasons, including content (e.g. the complexity of science, linguistic obstacles) as well as implementation challenges (e.g. the size of the target audience, resource constraints). Whether policymaking/decision-making regulatory institutions' (such as the European Commission) or scientific advisory bodies' (such as EMA and EFSA) public engagement activities are structured and devised around representative groups such as consumer organisations, non-governmental organisations, industry associations. Yet, the discussion in Section 3.1 above on representativeness hints at the limitations in such an approach insofar as it aspires to engage with citizens. This need not be the case, because everyday people can be motivated to engage and contribute to science – even in decision-making on scientific issues – but their engagement needs to be earned. How this is done depends on different factors. Flashpoint issues may be the trigger that provides the motivational context (e.g. children's health and immunisation) that is highly influential in activating citizens. Creativity is essential to engage with them, i.e. which channels, formats, messages, context.

As with other agencies, the Federal Institute for Risk Assessment (BfR) has faced pressure in recent years to extend its engagement model. The German agency is starting to tackle the key conundrum: their own surveys of the public indicate consumers as one of the most important groups with which to engage (with 39% considering it important and 46% very important, second only to science), yet consumers are also perceived to be the least influential group (Götte et al., 2017; Dendler and Böl, in review). Effective communication is a dominant issue in ensuring clarity on the expected goals and

outcomes from participants in consumer engagement. While BfR engages its stakeholders in various ways (Böl and Hensel, 2009), there are several obstacles familiar to those with experience that are shared by other agencies: how much decision-making should be outsourced, how to avoid stakeholder fatigue, can heterogeneous stakeholders (e.g. limited vs. plentiful resources) be treated/supported to ensure equal representation, as well as conflicts over what exists (ontological) and what is known (epistemological). These controversies require variegated approaches to ensure effective selection of stakeholders whose engagement level is defined not only by the topic, but also by the objective of the engagement endeavour (pragmatic vs. strategic vs. normative).

Since 2015, the UK Food Standards Agency (FSA) has also taken steps to develop a framework for citizen engagement based on social research insights to understand the wider interests of citizens in the food system. These include quantitative, qualitative and deliberative work to know (a) the understanding, concern, hopes and fears of UK citizens when it comes to the food system (FSA, 2016); (b) the expectations that consumers have of the food industry and its regulator in terms of transparency (FSA, 2017); and (c) the nature of public trust in the food system including its regulator (FSA, 2018). In 2016, a series of public dialogues was held across the United Kingdom, involving hundreds of members of the general public discussing the results in an open event bringing together more than 200 stakeholders in the food industry and watched by a further 2,000-plus participants via web streaming.

There are additional benefits over and above direct access to the values and preferences of the people and communities that public authorities serve. While opening people's eyes to the complexity of the food system can initially result in a naturally anxious response, over time, careful and creative research methods and open and honest dialogue lead to a more informed and resilient level of trust, based on the perceived values of the organisation, that can be leant on when mistakes are made. As was stated: 'Engaging is an investment in trustworthiness, you take people from a position of blind faith, to a degree of trust beyond what you originally may have expected' (Patel, 2018).

As was stressed, engagement can work: 'The world is not too polarised or too sensitive/late, to bring people on board. Science is a way of making sense of the natural world. That's the same if you read Nature/Science or get your news from Facebook' (Brown, 2018).

3.2.2. Improving risk assessment processes through inputs from society

Transparency and engagement are frequently debated and dissected in the currency of trust or public confidence in scientific advisory bodies, arguably the most coveted inputs that society can deliver to such organisations. But contributing to science could in some instances be just as valid a means of strengthening the quality of science.

ANSES's programme to invest in buy-in and qualitative input from civil society was formally encoded in the Agency's 2011 charter on open expertise to society. Upstream engagement at ANSES transcends the knowledge deficit model: stakeholders can initiate requests for scientific advice, take part in hearings and framing groups before and during the risk assessment process, thus assisting in problem formulation and potentially identifying and providing access to new streams of data. Expert groups can interview interested stakeholders to access lay knowledge on specific issues and experience from the field, discover additional studies and learn about societal context. The Agency's mission is not necessarily to engage directly in public debate, rather to build capacity and facilitate civil society's contribution in this engagement model through, for example, feedback meetings and training sessions. There remain obstacles such as limited financial/human resources, managing the dialogue (e.g. public consultations can postpone assessments by months), empowering the public to understand scientific work and then managing their expectations in this process. For ANSES, the overall process is worth the investment as it improves equity among stakeholders, contributes to capacity building, lessens the likelihood of crisis of confidence in the system and broadens the reach of published scientific assessments.

The potential for society to contribute to scientific risk assessment processes is manifesting itself in a variety of new forms and channels. Crowdsourcing/solving and citizen sourcing by a potentially unlimited pool of 'people scientists' are realities in some fields (seismic detection, genealogy research, industrial design). Increasing numbers of public bodies aspire to imitate them. Such interactions and openness to societal contributions can not only alleviate pressure on increasingly stretched public finances but also release new sources of data, critical thinking and knowledge, maximising scientific output. Strategic consideration of the benefits for science helps to develop and channel this potential into risk assessment.

EFSA is employing a broad set of mechanisms for harnessing society's contributions – some well-established channels for interaction, others more recent additions or currently in pilot or testing phases – to its risk assessment activities since setting out its vision for a 'Transformation to an Open EFSA' in 2015 (EFSA, 2015). The scientific quality of EFSA's assessments has four critical components: the degree of transparency, the degree of engagement, the degree of impartiality and the degree of methodological rigour. For EFSA, transparency – i.e. clarity on the actors involved, choices, processes, methods, data, assumptions, interpretations and level of uncertainty that is also accessible – leads to engagement (information, consultation, participation). This in turn produces tangible scientific inputs: data which become evidence as they are transformed into knowledge. But impartiality and methodological rigour are two additional strategic requirements that help to define a social engagement model designed to improve the quality of science itself.

'Impartiality' is the extent to which bias due to preconceptions or expectations owing to any prior knowledge or type of vested interest is minimised in the process. Arguably, this is most evident in the values of scientific experts, and their familiarity with and previous knowledge/experience of assessment questions. This should and can be minimised by opening up the assessment. Impartiality can be summarised as 'plan before you do'. This can be optimised by consultations on scientific protocols – a detailed plan of what, how and why an assessment is carried out. Examples from EFSA include a comprehensive consultation on the protocol for the Authority's next assessment of the controversial food contact material polymer bisphenol A, scheduled for completion in 2020. This process undoubtedly shaped the final form of the protocol and may have excluded the prospect of allegations of partiality from some sources.

'Methodological rigour' concerns the degree to which systematic and random error are minimised, representativeness and generalisability maximised, and scientific uncertainties accounted for. Optimising this rigour can take various forms that, from EFSA's experiences, include consultations on guidance documents – the methodological frameworks for scientific assessments – such as a standardised and transparent process for eliciting expert knowledge (that also contributes to limiting bias). EFSA has undertaken pilot crowdsourcing projects for innovation ideas and data gathering. For example, solvers from all over the world contributed ideas for visualising scientific uncertainty. The Authority also makes large amounts of its data, scientific methodologies and assessment tools available on its open access EFSA Journal, Data Warehouse and Knowledge Junction platforms so that others can repeat EFSA's assessments using the same inputs and tools.

Engagement is also being used as a tool to improve communication. The Italian Ministry of Health's 'constant and constructive dialogue' with producers and consumers is an intrinsic part of its mission. The Consulta delle associazioni dei produttori e dei consumatori (Council of producer and consumer associations) reviews and shares information on sensible eating and promotes healthy diets among citizens. It also serves as a sounding board for interventions from the technical and scientific section of the Comitato nazionale per la sicurezza alimentare (National committee for food safety), the Council's parent institution. The two bodies jointly oversee how to anticipate the needs of stakeholders through institutional communication campaigns, a thematic 'FOOD' channel that broadcasts TV documentaries on priority themes and promotion of the interconnectedness of food safety topics, and other means. The Council monitors misinformation and works to combat fake news in food safety and public health through targeted dissemination of verified communications to the media and on institutional sites. Working with stakeholders also allows testing of communications on smaller audience segments before exposing them to the general public and helps in measuring the impact of communication. For example, indicators such as the notifications from the national system on food-borne diseases have been pivotal in monitoring and measuring communication. Empowering stakeholders to take responsibility in this way has increased engagement and aided transparency.

In the panel discussions closing the 'Engaging with Society' session, these mechanisms were welcomed, but with caveats. The public requires an upfront explanation of the context, so agencies need to research and understand what motivates people to listen/participate, and communication is critical in this. Also, engagement during problem formulation such as that pursued by ANSES and EFSA should uphold basic ethical principles, e.g. if jobs are at stake, this should be made public. The panellists agreed that these processes should not be developed so that advisory bodies hide behind them as a form of abdication of responsibility.

4. Conclusions: research needs for future communication and engagement

Using societal insights and providing platforms for engagement with the ultimate beneficiaries of its findings is shaping the future delivery of regulatory science. The presentations during the 'Engaging with Society' session that described today's information ecosystem, together with elaborations on approaches to public engagement and lessons from regulatory bodies prompted an important question – what sort of research is required to generate evidence and practice that can inform the design of communication and participation activities?

What drives efficient communication is the extent to which it can meet the needs of target audiences. In the domain of public institutions, attempting to unpack such needs implies conducting research on public awareness, understanding, perceptions and expectations. The results can contribute to informed decisions about which topics to focus on, prompt the development of campaign-based communication activities that integrate awareness-raising or inform us how audiences wish to interact with science-related information. Research techniques employed can vary, ranging from traditional tools such as surveys or focus groups to more innovative techniques – for example, echo-chamber mapping and netnography. In either case, qualitative and quantitative methods are required to map information acquisition and production patterns. And to foster an efficient consumption of information, media strategies must be designed that rely on proactive communication tailored to modern modes of information acquisition and supportive of the needs of media and journalists.

Resource requirements to generate this evidence are steep – much beyond the budgets of individual organisations active in regulatory science. To address this challenge realistically, two principles will be crucial: (i) methodology harmonisation and data sharing to allow multiple uses of findings and comparability across different actors (for example, European institutions and EU Member States); and (ii) partnering with peer organisations and academia to share resources to generate evidence and mutually beneficial international research agendas. In the risk assessment ecosystem, these principles are common in the area of natural sciences; they should now be extended to include relevant social science disciplines.

Research on the effectiveness of communication should take into account its multidirectional nature, focussing on the engagement dimension and on how this could enable incorporating societal perspectives into regulatory science-making. Various public engagement mechanisms have been developed and tested to allow effective public and stakeholder engagement – not just in the context of an open and honest risk communication process, but more broadly within different stages of risk analysis. In an area where there are no one-size-fits-all solutions, appropriate engagement must consider a number of factors. Balanced representation is one of them – particularly important, yet often challenging to achieve. Research on the participation gaps – looking at disengaged audiences –in current engagement approaches is required to analyse the extent to which the views of actual participants can be considered as representatives of the public at large. Testing the effectiveness of mechanisms employed is another – where a periodic quality check can ensure that the efforts are not limited to a set of outreach activities, and that interested parties feel they can adequately inform the scientific process, without endangering its independence.

In summary, societal insights have a pivotal, almost prerequisite role in informing communication and engagement strategies and related governance systems. In addition, a front-to-end participatory process has the potential to reduce the 'news factor' of science communication, rather becoming a continuation of a dialogue on newly-generated knowledge that builds on societal values. Regulatory bodies should therefore be encouraged to invest, promote and use social research to help understand these values and inform their work in a way that improves the quality, legitimacy and authority of the scientific process.

5. Recommendations

The session produced several recommendations upon which EFSA can build and which can inform its future 'Strategy 2027' in relation to the issue of engaging with society:

- Frame social research to examine public awareness, understanding, perceptions and expectations in the area of food safety, using a mix of qualitative and quantitative methods.
- Use insights from social research to inform the design of risk communication activities, adapting them to the information needs of target audiences. In other words, adapt

communication to contextualise risk assessments based on an understanding of societal concerns.
- Maintain and strengthen mechanisms to ensure an open dialogue with stakeholders and citizens. To ensure effective involvement throughout the risk analysis process: (i) invest in effective tools and methods that support engagement; (ii) ensure balanced representation of interested parties; and (iii) periodically assess the extent of the resulting contributions to the scientific process.

References

Böl GF and Hensel A, 2009. Tasks and public perception of the Federal Institute for Risk Assessment. Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz, 52, 1179–1187. https://doi.org/10.1007/s00103-009-0967-5

Brown T, 2018. We don't live in a post-truth society. Presentation at EFSA's 3rd Scientific Conference 'Science, Food and Society' (Parma, Italy, 18–21 September 2018). Available online: https://www.youtube.com/watch?v=wPWNKKxfy60&t=561s

Bucchi M, 2018. Quality of information, public engagement and the challenges of science communication 2.0. Presentation at EFSA's 3rd Scientific Conference 'Science, Food and Society' (Parma, Italy, 18–21 September 2018). Available online: https://www.youtube.com/watch?v=iQZtcAyBTWE

Bucchi M and Sarracino B, 2018. Scienza, tecnologia e opinione pubblica in Italia nel 2017. In: Pellegrini G (ed.). Annuario Scienza Tecnologia e Società. Il Mulino, Bologna, IT. pp. 11–39.

Castelfranchi Y and Pitrelli N, 2007. Come si comunica la scienza. Editori Laterza, Roma, IT. 148 pp.

Del Vicario M, Vivaldo G, Bessi A, Zollo F, Scala A, Caldarelli G and Quattrociocchi W, 2016. Echo chambers: emotional contagion and group polarization on Facebook. Scientific Reports, 6, 37825. https://doi.org/10.1038/srep37825

Dendler L and Böl GF, Increasing participation in science: reflections from the field of science-based risk assessment, in press.

Devos Y, Elliott KC, Macdonald P, McComas K, Parrino L, Vrbos D, Robinson T, Spiegelhalter D and Gallani B, 2019. Conducting fit-for-purpose food safety risk assessments. EFSA Journal Special Issue July 2019, Third EFSA Conference on Science, Food and Society.

EFSA (European Food Safety Authority), 2015. Transformation to an open EFSA: preliminary implementation plan. 8 pp. Available online: https://www.efsa.europa.eu/sites/default/files/corporate_publications/files/openefsapreliminaryimplementationplan150327.pdf

EFSA (European Food Safety Authority), 2019. Guidance on communication of uncertainty in scientific assessments. EFSA Journal 2019;17(1):5520, 73 pp. https://doi.org/10.2903/j.efsa.2019.5520

Engage2020, 2015. Engage2020 action catalogue. Available online: http://actioncatalogue.eu

Felt U and Fochler M, 2010. Machineries for making publics: inscribing and de-scribing publics in public engagement. Minerva, 48, 219–238. https://doi.org/10.1007/s11024-010-9155-x

FSA (Food Standards Agency), 2016. Our food future. FSA, UK. 50 pp. Available online: https://www.food.gov.uk/sites/default/files/media/document/our-food-future-full-report.pdf

FSA (Food Standards Agency), 2017. Food standards agency transparency: understanding public views and priorities. FSA, UK. 78 pp. Available online: https://www.food.gov.uk/sites/default/files/media/document/fsatransparencyreport.pdf

FSA (Food Standards Agency), 2018. Trust in a changing world. FSA, UK. 2 pp. Available online: https://www.food.gov.uk/research/research-projects/trust-in-a-changing-world

Götte S, Koch S, Epp A, Lohmann M and Böl G-F, 2017. BfR-Stakeholder- und Bevölkerungsbefragung: Vierte Evaluation zum gesundheitlichen Verbraucherschutz in Deutschland; Endbericht. Bundesinstitut für Risikobewertung, Berlin. Available online: https://mobil.bfr.bund.de/cm/350/bfr-stakeholder-und-bevoelkerungsbefragung-vierte-evaluation-zum-gesundheitlichen-verbraucherschutz-in-deutschland.pdf

ICF, Etienne J, Chirico S, Gunabalasingham T and Jarvis A, 2018. Final report: clear communications and uncertainty. EFSA Supporting Publication 2018;15(5):EN-1412, 94 pp. https://doi.org/10.2903/sp.efsa.2018.en-1412

ICF, McEntaggart K, Chirico S, Etienne J, Rigoni M, Papoutsis S and Leather J, 2019. EU insights chemical mixtures awareness, understanding and risk perceptions. EFSA Supporting Publication 2016;16(3):EN-1602, 113 pp. https://doi.org/10.2903/sp.efsa.2019.en-1602

Jasanoff S, 1995. Procedural choices in regulatory science. Technology in Society, 17, 279–293. https://doi.org/10.1016/0160-791X(95)00011-F

Kahneman D, 2011. Thinking, fast and slow. 1st Edition. Farrar, Straus and Giroux, New York, NY. 499 pp.

Krishnaswamy K, 2018. Observing news media in the misinformation ecosystem: The case of public health communications. Presentation at EFSA's 3rd Scientific Conference 'Science, Food and Society' (Parma, Italy, 18–21 September 2018). Available online: https://www.youtube.com/watch?v=M8BfoQCNc-Q

Löfstedt RE, 2004. Risk communication and management in the twenty-first century. International Public Management Journal, 7, 335–346.

Löfstedt RE, 2018. Conceptualizing and communicating risk in "post-trust societies". Presentation at EFSA's 3rd Scientific Conference 'Science, Food and Society' (Parma, Italy, 18–21 September 2018). Available online: https://www.youtube.com/watch?v=iQZtcAyBTWE

Löfstedt RE and Renn O, 1997. The Brent Spar controversy: an example of risk communication gone wrong. Risk Analysis, 17, 131–136. https://doi.org/10.1111/j.1539-6924.1997.tb00852.x

Parvin P, 2018. Democracy without participation: a new politics for a disengaged era. Res Publica, 24, 31–52. https://doi.org/10.1007/s11158-017-9382-1

Patel M, 2018. Social research strategies to explore trust in food and its regulator. Presentation at EFSA's 3rd Scientific Conference 'Science, Food and Society' (Parma, Italy, 18–21 September 2018). Available online: https://www.youtube.com/watch?v=UsXEYRQmJw0

Pidgeon NF, Kasperson RE, Slovic P eds., 2003. The Social Amplification of Risk. Cambridge University Press, Cambridge, UK. 468 pp. https://doi.org/10.1017/cbo9780511550461

Rowe G and Frewer LJ, 2005. A typology of public engagement mechanisms. Science, Technology & Human Values, 30, 251–290. https://doi.org/10.1177/0162243904271724

Slovic P, 1987. Perception of risk. Science, 236, 280–285. https://doi.org/10.1126/science.3563507

Sunstein CR, 2002. The law of group polarization. Journal of Political Philosophy, 10, 175–195. https://doi.org/10.1111/1467-9760.00148

Thaler RH, 2016. Misbehaving: the making of behavioral economics. 1st Edition. WW Norton & Company, New York, NY. 432 pp.

Walls J, Rowe G and Frewer LJ, 2011. Stakeholder engagement in food risk management: evaluation of an iterated workshop approach. Public Understanding of Science, 20, 241–260. https://doi.org/10.1177/0963662509354543

Zollo F, Bessi A, Del Vicario M, Scala A, Caldarelli G, Shekhtman L, Havlin S and Quattrociocchi W, 2017. Debunking in a world of tribes. PLoS ONE, 12, e0181821. https://doi.org/10.1371/journal.pone.0181821

Abbreviations

ANSES	Agency for Food, Environmental and Occupational Health and Safety (France)
BfR	Federal Institute for Risk Assessment (Germany)
CASP	Critical Appraisal Skills Programme
CDC	US Centers for Disease Control and Prevention
EMA	European Medicines Agency
FSA	UK Food Standards Agency
NGO	Non-Governmental Organisation