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Evidence based uncertainty: what is needed now?

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The value of social sciences in understanding how experts and non-experts conceptualise, interpret and communicate risk and uncertainty is most evident in the applied world of risk assessment (for a recent review of the issues see, van der Bles et al. 2019). We cannot escape the reach of risk assessment, since without being able to establish what constitutes a risk (as well as potential benefit) and how sure, or not, the assessor is in establishing that risk, many aspects of our daily lives such as the roads we drive on, the home appliances we buy, the pharmaceuticals we take to relieve our health ailments, and the food we consume, would be a lot less safe.

The European Food Safety Authority (EFSA) is an example of a regulatory body that, under its remit, advises on the risks associated with food, by considering the factors that contribute to food safety across the entire food chain (from production – e.g. farming and feed to animals, through to distribution – e.g. the food we order from a take away). EFSA takes a world leading role in setting agendas for the type of practices that risk assessors, primarily, but also other stake holders (e.g., risk managers, risk communicators, industry, consumers, special interest groups) ought to adopt in order to keep up to date with advances in academic research on risk analysis (incl. risk assessment, risk management, risk communication). Keeping up to date with new insights and apply it to practice requires an agile approach that is able to incorporate and synthesis new understandings of how to quantify risk, how best to analyses uncertainties associated with the risk being assessed, and how to package risk and uncertainty in ways that are easily interpreted by a variety of audiences (with varying degrees of familiarity with the concepts), and above all in the most transparent way possible. The focus of this piece is to consider the corollary to this. Once the translation of new insights into guidance for practitioners has been undertaken, as EFSA has done with two recently published guidance documents on uncertainty analyses around risk assessment (EFSA 2018) and the communication of uncertainty around risk assessment (EFSA 2019), what factors need to be taken into account to actually put these recommendations into practice? The two guidance documents are clearly related. The former considers the critical factors in formalising a process that enables risk assessors to report on their uncertainties during the process of conducting their assessment, and how to incorporate those uncertainties into the assessment report they prepare (for details on this see Osman 2016; Osman, Heath, and Löfstedt 2018). The latter is focused on characterising different forms that uncertainties take in the risk assessment process, and how best to communicate them, by being sensitive to the needs of different stake holders across the food chain. The focus on the remainder of this piece is primarily on the latter of the two guidance documents published by EFSA, regarding the

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communication of uncertainty (EFSA 2019), though the points made also generalise to guidance on analysing uncertainty (EFSA 2018).

Over the years there has been multiple conversations on both sides of the Atlantic regarding uncertainty within the policy domain. In particular, the discussions have focused on establishing what meaningful approaches should be taken in making transparent uncertainty analyses associated with risk assessments themselves. The other focus has been on how to best communicate scientific uncertainty in light of the call from some (e.g. EFSA 2018, 2019) to make the process of conducting uncertainty analyses more transparent to different audiences, with particular priority on the consumer.

What does transparency mean in this context? Discussions about the greater need to make uncertainty analyses transparent to decision-makers and other stake holders isn't new, and has been made in a variety of contexts (e.g., climate change, Larsen, Kørnøv, and Driscoll 2013; environmental risks, Lees et al. 2016; Tenney, Kvaerner, and Gjerstad 2006; flooding, Merz & Thieken, 2005; waste disposal, Jalava et al. 2013). Discussions have shifted away from early work highlighting the fact that risk assessors performing uncertainty analyses often overlooked communicating uncertainties to risk managers and other decision-makers (e.g., Tenney, Kvaerner, and Gjerstad 2006), which then lead to calls for greater level of communication of uncertainties between different actors across the risk analysis process. Instead, the matter of concern in the academic world now is what level of detail is needed in order to convey to different stakeholder, the uncertainties that risk assessors face regarding the input data and the assumptions that they are having to make when conducting their risk analysis, especially when the analysis is required under strict deadlines, with high stakes attached to the outcome of the assessment (e.g. see Osman 2016). Though more controversial discussions are still being had about what the function of communicating uncertainty analyses should be beyond those that are required to make decisions based upon this information.

Alongside the need to consider the features that uncertainty analyses should take, and how to formalise the process so that the communication of uncertainties serves a useful purpose in the decision-making of risk managers, regulators such as EFSA, have drawn attention to other stakeholders and their needs. For EFSA, the aim of the new uncertainty approach is to make scientific advice more transparent and robust because of increasing demands from citizens, consumers and representatives of civil society. As Prof Tony Hardy, the chair of EFSA's Scientific Committee commented "We have concluded that EFSA will benefit from applying and adopting the approach across the wider variety of scientific areas and types of assessments it carries out." (Hardy 2018)

This presents an immense challenge to any regulator that has to find a way to capture uncertainties appropriately, and then consider the diversity of opinions that exist amongst research communities, as well as the different ways in which uncertainties from risk assessment are likely to be viewed by policy makers, industry, the media, citizens, and consumers. For this reason, EFSA's pioneering effort on providing guidance documents on uncertainty analyses, and the communication of uncertainties, should be applauded.

Evidence based uncertainty: What is needed now? This was considered as part of a themed workshop that took place in March 2019. The workshop assembled a group of distinguished scholars and practitioners at the UK Royal Society with expertise in the area of risk and uncertainty. They were asked to consider and reflect the academic quality of the EFSA (2018) and EFSA (2019) guidance documents and to put forward suggestions on what regulatory agencies such as EFSA and the UK Food Standards should do now going forward in this space.

The nine key discussion points were raised in response to the broad title question of the workshop. These are condensed and organised into two categories ([1] making future guidance documents on uncertainty communication maximally persuasive; [2] increasing engagement when developing future guidance documents on uncertainty communication), each of which

have a bearing on the recent work by EFSA that have been discussed thus far. The discussion points should be taken as current converging reflections from a highly expert and informed community of researchers and practitioners that have considerable experience in risk analysis.

Category 1: Making future guidance documents on uncertainty communication maximally persuasive.(Fischhoff 2019)

	Discussion Point	References
Rhetorical features of persuasive guidance documentation for practitioners	**Providing examples:** Recommendations as to how to communicate uncertainty to audiences with different expertise and backgrounds require careful use of illustrative examples of how statements should be formulated, for the same illustration, to meet the needs of different audiences. *From this it is possible for practitioners to learn from example how to adjust their communication of uncertainties to different audiences*	Fischhoff et al. 2011; Fischhoff and Davis, 2014
	Providing justification: Illustrative example statements that are nuanced for the needs of different audiences requires explanation for why they are constructed in the way that they are. *From this it is possible for practitioners to learn to adopt best practices for the communication of uncertainties to different audiences because they understand the rationale behind why and how they need to be adjusted.*	Giles 2002; Fenton and Neil 2012; Lempert et al. 2004
	Pre-testing recommendations: Devising and then recommending methodological approaches for constructing messages regarding the communication of uncertainties around risk assessment to multiple audience requires pretesting. *Doing so ensures confidence in practitioners in the methods they are using and the statements they are generating containing details about uncertainties. This is because the methods and statements would have already been empirically tested, so that practitioners have advanced knowledge of the likely interpretations and reactions that different audiences will have in response to those statements.*	Fischhoff 2013, 2018, 2019
	Post-testing guidance: Devising guidance documents that provide recommendations regarding the methods and practices that should be adopted when conducting uncertainty analyses and communicating uncertainties to multiple audiences should be peer reviewed, and the recommendations regarding messaging containing statements about uncertainties should also be evaluated at regular intervals by multiple stake holders to determine efficacy. *From this it is possible for practitioners to feel confident that the guidance they are receiving from regulators has been evaluated and scrutinised by multiple expert communities, so that the most effective and most robustly empirically validated methodologies have*	Kasperson and Palmlund 1988

(*continued*)

Continued.

	Discussion Point	References
	been recommended to support the analysis and communication of uncertainties.	
	Scope: Recommendations as to how to communicate uncertainty require contextualisation, which requires the need to present the details of how to implement best practices in communication to different audiences by identifying the relevance of this process across risk analysis as a whole. *From this it is possible for practitioners to see the communication of uncertainties in relation to balancing risks and benefits or achieving risk-risk trade-offs, and to see the value of adopting new recommendations on communicating uncertainties because this is an activity that underpin the whole risk analysis process.*	Aven and Renn 2019; Fischhoff 2015; Graham 2008; Graham and Wiener 1995; Hohenemser, Kates, and Slovic 1983; Renn et al. 2007; Renn 2008
	Breadth: Demonstrating the wide applicability of recommendation on the communication of uncertainties requires the provision of illustrative examples of successful practices in the communication of uncertainties from a wide array of sectors and countries[1,2]. *Doing this makes it possible for the regulator to show their breadth because they can adopt practices elsewhere as well as generalise their own practices beyond their own sector, and share best practices amongst international counterparts.*	Cope et al. 2010; Leung et al. 2015

Category 2: Increasing engagement when developing future guidance documents on uncertainty communication.

	Discussion Point	References
Developing a strategy for engagement of multiple and diverse expert audiences	**Engaging all those in Risk analysis**: Maximising engagement requires building opportunities for dialogue between risk assessors, risk managers and risk communicators, though it should be acknowledged that many share multiple roles across the risk analysis process working in the uncertainty space.[3] We feel that forums at the Society for Risk Analysis could help in developing such dialogues. *Doing this makes it possible for the regulator to take advantage of developing better engagement of all actors across the risk analysis process by integrating the experiences of both the risk assessors and risk managers, given that both parties need to have established common ground in the way in which they explain and communicate relevant factors that are included and excluded from guidance documents*	Fischhoff 1995; Osman, Heath, and Löfstedt 2018; Pidgeon 1991

(*continued*)

Continued.

	Discussion Point	References
	on communicating uncertainties effectively.	
	Academic engagement: Maximising engagement between regulators preparing guidance documents on communicating uncertainty and other expert communities requires closer involvement of academic communities in the early development of guidance documents. For instance, once such discipline is the social sciences, given that they have a long history of investing ways to optimise the communication of uncertainties to a wide range of audiences[4]. *Doing this makes it possible for the regulator to take advantage of existing expertise based on the most advanced empirical insights in order to determine best practices amongst academic communicates that could be applied in practice, in conjunction with identifying the needs of those in the risk analysis process*	Fischhoff 2013, 2015, 2019; Johnson and Slovic 1995, 1998; Lofstedt and Bouder 2017; Lofstedt, McLoughlin, and Osman 2017; Osman, Heath, and Löfstedt 2018; Pidgeon et al. 1992; van der Bles et al. 2019
	Multi-disciplinary and multi-sector engagement: Maximising engagement between regulators and other domains of expertise requires going beyond canvassing view of those with the most direct experience of uncertainty analyses (e.g., risk assessors), and going beyond into areas of expertise that spans multiple disciplines (e.g., psychologists, risk communication, management, statisticians, computer scientists, ethicists) and multiple sectors (incl. industry, special interest groups, media, citizens). *Doing this makes it possible for the regulator to take advantage of developing better engagement and facilitate the promotion and uptake policy changes in the area of uncertainty analysis and communication of it.*	Fischhoff 2013, 2015, 2019

Conclusions

EFSA should be congratulated for initiating this path breaking work on uncertainty in Europe. This was an important first step to inject transparency into the broader risk assessment process. That said, the group meeting at the Royal Society felt that more could be done including the empirically testing the claims that EFSA made in both the documents, to making a more user-friendly shortened version of the document, and finally to evaluate whether stakeholders and consumers actually understand EFSA's various uncertainty measures. As Baruch Fischhoff reminded us a number of years ago:

> One should no more release an untested risk communication message than an untested drug. (Fischhoff 1998, p.70)

Notes

1. One way to achieve this would be to have several mini-summits in cities including Brasilia, Brussels, Tokyo and Washington DC with a range of regulators attending each local summit.
2. Key institutional actors involved in further developments of uncertainty guidance documentation could be better supported by clear institutional challenges that are set, either by the Chief Scientific Advisor (as is the norm in the UK policy system) or by the Science Advisory Mechanism (SAM which is the case in the European Commission).
3. For instance, with respect to EFSA, there could be greater engagement between them and Directorate General SANTE – this is the directorate general responsible for the implementation of European Union laws on the safety of food and other products. The reason that forging closer associations would help to illuminate areas of possible misunderstanding, as well as identify areas of common practice and best practice in communicating uncertainty from analyses within EFSA's risk assessments and beyond.
4. Key institutional actors involved in further developments of uncertainty guidance documentation could be better supported by clear institutional challenges that are set, either by the Chief Scientific Advisor (as is the norm in the UK policy system) or by the Science Advisory Mechanism (SAM which is the case in the European Commission).

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