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Public risk perception and environmental policy

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Public risk perception and environmental policy

Contents

Introduction	3
Theories of risk perception	4
Communicating risk	6
Incorporating public risk perception into policy: towards an effective dialogue	9
Conclusions	10
References	10

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Introduction

Public risk perception and environmental policy

Balancing risks and benefits is a central part of any policymaking and environmental and international policymakers have a particularly complex task, as they need to encompass many variables and involve numerous stakeholders.

As stated in the 7th Environment Action Programme, a systematic approach to environmental risk management will improve the European Union's capacity to identify and act upon technological developments in a timely manner. However, to develop such an approach it is important to be aware that the way the 'public' – people with a generalised knowledge – perceive risk does not always align with the best estimates of risk calculated by scientific experts.

While risk frameworks can be used to collate large amounts of data and perform complex analyses to arrive at objective estimates of risk, the public makes judgements without such specialised techniques, and this has been shown to result in a tendency towards over- or under-estimation of certain risks (Renn & Rohrmann, 2000a). For example, the risks of indoor compared to outdoor air pollution are generally severely underestimated by the public (Margolis, 1996). Since public uptake can determine the success or failure of any policy, understanding why such over- or under-estimations occur is imperative for the success of public policy.

The question is whether the differences in perception between the public and the experts should be accounted for in risk management practices; and in the light of these differences, should policy be shaped by the opinion of experts at all? This Future Brief from Science for Environment Policy examines the latest research on these differing risk perceptions and explores ways to improve the probability of getting the balance right.

1. Theories of risk perception

1.1 What drives the public tendency to view risk differently from experts?

Members of the public are often presented with a large amount of information on a topic that concerns them and require some way of weighing up that information if they want to reach a conclusion about relevant risks. In general, the public relies on what are called 'intuitive heuristics' or - more commonly - rules of thumb. Heuristics are quick, informal methods that the brain uses to generate an approximate answer to a problem and allow us to quickly make sense of a complex environment (Renn & Rohrmann, 2000a; Reid, 2006; Renn, 2008). However, using intuitive heuristics can also result in bias.

For example, as a result of the 'availability bias', individuals are more likely to perceive an event as more probable if they are able to imagine or recall such events easily (Eiser *et al.*, 2012; Reid, 2006). For instance, if someone has experienced a flood they are likely to see one as more probable in the future. Consequently, personal experience can be very important in perception of the level of risk, and reminders of particular risks in the media can also have an effect (Eiser *et al.*, 2012; Wahlberg & Sjoberg, 2000; Kitzinger, 1999).

Another important bias is that individuals tend to overestimate the potential for exposure and the extent of a hazard, leading them to assume that the mere presence of certain substances is harmful (Renn *et al.*, 1992). In a hypothetical situation in which the collected scientific evidence is in agreement that the dose or concentration of a substance is below the threshold of causing harm, the public may still show a tendency to assume that any exposure is harmful (Renn *et al.*, 1992; Gigerenzer, 2001). In the absence of advanced modelling, "any exposure is regarded as being negative irrespective of dose and exposure" (Renn *et al.*, 1992).

The characteristics of particular risks also influence how they are perceived by the public (Bickerstaff, 2004; Meng *et al.*, 2013; Birkholz *et al.*, 2014; Renn, 2004). Early research identified two factors, labelled 'dread' and 'unknown', which are especially associated with risk tolerance.

Figure 1, based on such early work, illustrates how the importance of these two characteristics was first identified. Fischhoff *et al.* (1978) asked 76 particpants to give a number of risks a score for nine different aspects including the voluntary or involuntary nature of exposure to the risk (i.e. whether people are able to choose whether they are exposed to the risk), whether the effects are immediate or delayed and whether the individual was in control of the risk, amongst others. The researchers then analysed how these scorings were correlated with each other and showed that the two over-arching factors: dread, shown on the horizontal axis of figure 1, and unknown, shown on the vertical axis, could be used to map the characteristics people associated with different risks.

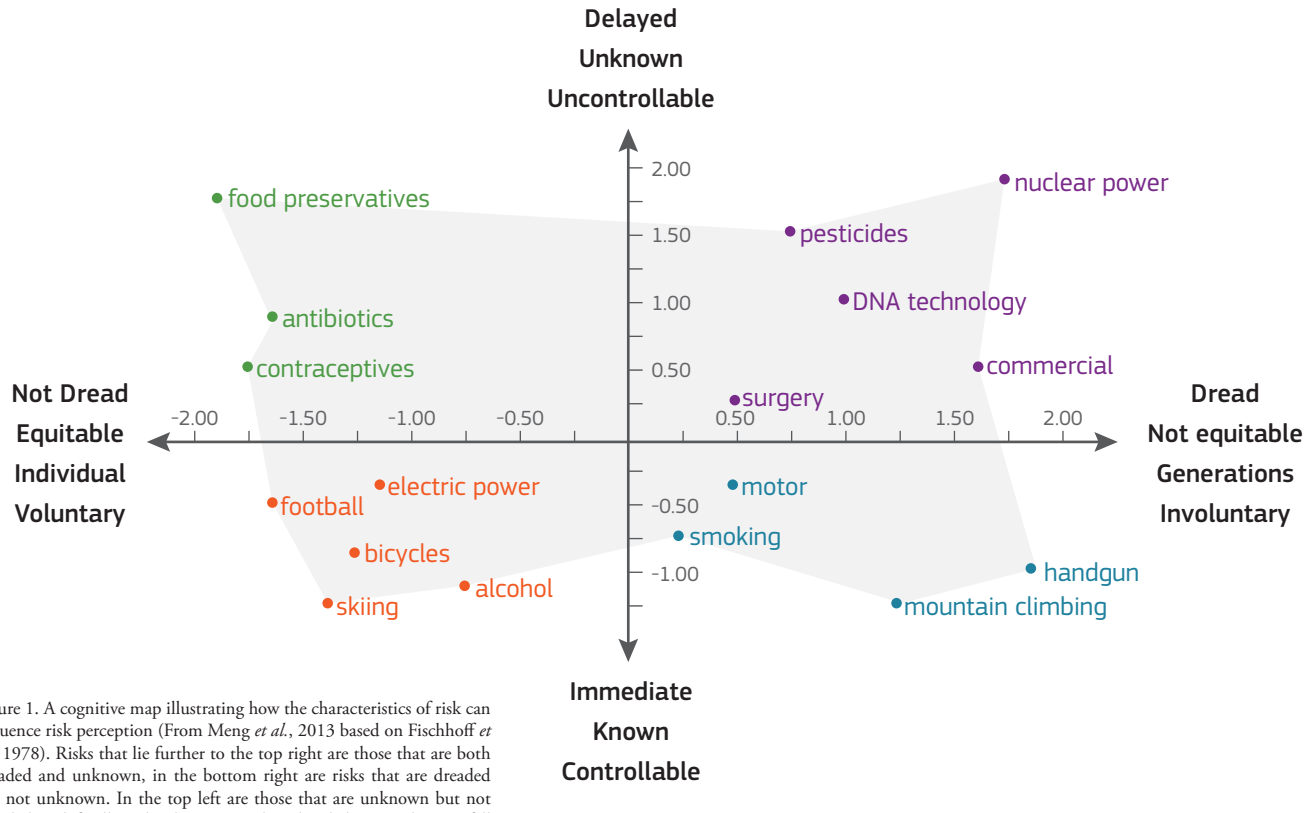

Figure 1. A cognitive map illustrating how the characteristics of risk can influence risk perception (From Meng *et al.*, 2013 based on Fischhoff *et al.*, 1978). Risks that lie further to the top right are those that are both dreaded and unknown, in the bottom right are risks that are dreaded but not unknown. In the top left are those that are unknown but not dreaded and finally risks that are neither dreaded nor unknown fall towards the bottom left.

'Dreaded' risks are seen as potentially catastrophic, uncontrollable and involuntary. 'Unknown' risks are unfamiliar, thought to be not well understood by science and associated with the possibility of delayed effects (Bickerstaff, 2004; Meng *et al.*, 2013; Frewer, 2004). Other important characteristics include: whether the source of the risk is seen as artificial (as opposed to 'natural', for example, pesticide contamination versus an earthquake), inequality in the distribution of the risk, and control of the risk by an institution, which can increase the perception of risk if the institution is not well-trusted (Renn, 2008).

Nuclear power, for example, is seen as having a high catastrophic potential and is involuntary, inequitable and uncontrollable by individuals, it is therefore placed far into the top right corner of figure 1. Genetic modification is unfamiliar, is possibly associated with delayed effects for future generations and, like nuclear power, is involuntary and beyond personal control. Conversly, electricity is familiar, under personal control and voluntary and hence lies towards the bottom left of figure 1.

1.2 Do different cultures or groups see risk differently?

Early risk perception research centred on the idea of a 'knowledge gap' between the public and the experts (Hilgartner, 1990; Wynne & Irwin, 1996). It was assumed that if the public could access and understand all the facts of a situation, their ideas about risk would tend to match those of the experts (Hansen *et al*, 2004; Bickerstaff, 2004; Touili *et al.*, 2014; Kane *et al.*, 2014).

However, this idea has been dismissed and researchers now recognise that knowledge is by no means the only factor determining perceptions of risk (Touili *et al.*, 2014; Pidgeon, 1998; Renn & Rohrmann, 2000a). Rather, risk perception is a complex product of innate biases (as discussed in Section 1.1) as well as social, cultural, political and emotional factors (Touili *et al.*, 2014; Pidgeon, 1998; Renn & Rohrmann, 2000a).

Figure 2 illustrates these complex layers of factors, which are both individual and collective, both innate and learned, and which interact to ultimately make up how people perceive risk (Renn, 2008). For instance, cultural differences are important. Compared with individuals in western Europe, for example, people from many eastern European countries are more likely to see economic or social risks as greater than technological risks. This is partly due to a strong, historically-founded distrust in economic and social governance institutions, and partly due to the promises that technological modernisation can bring for improving quality of life in countries that have much to gain in this area (Renn & Rohrmann, 2000a).

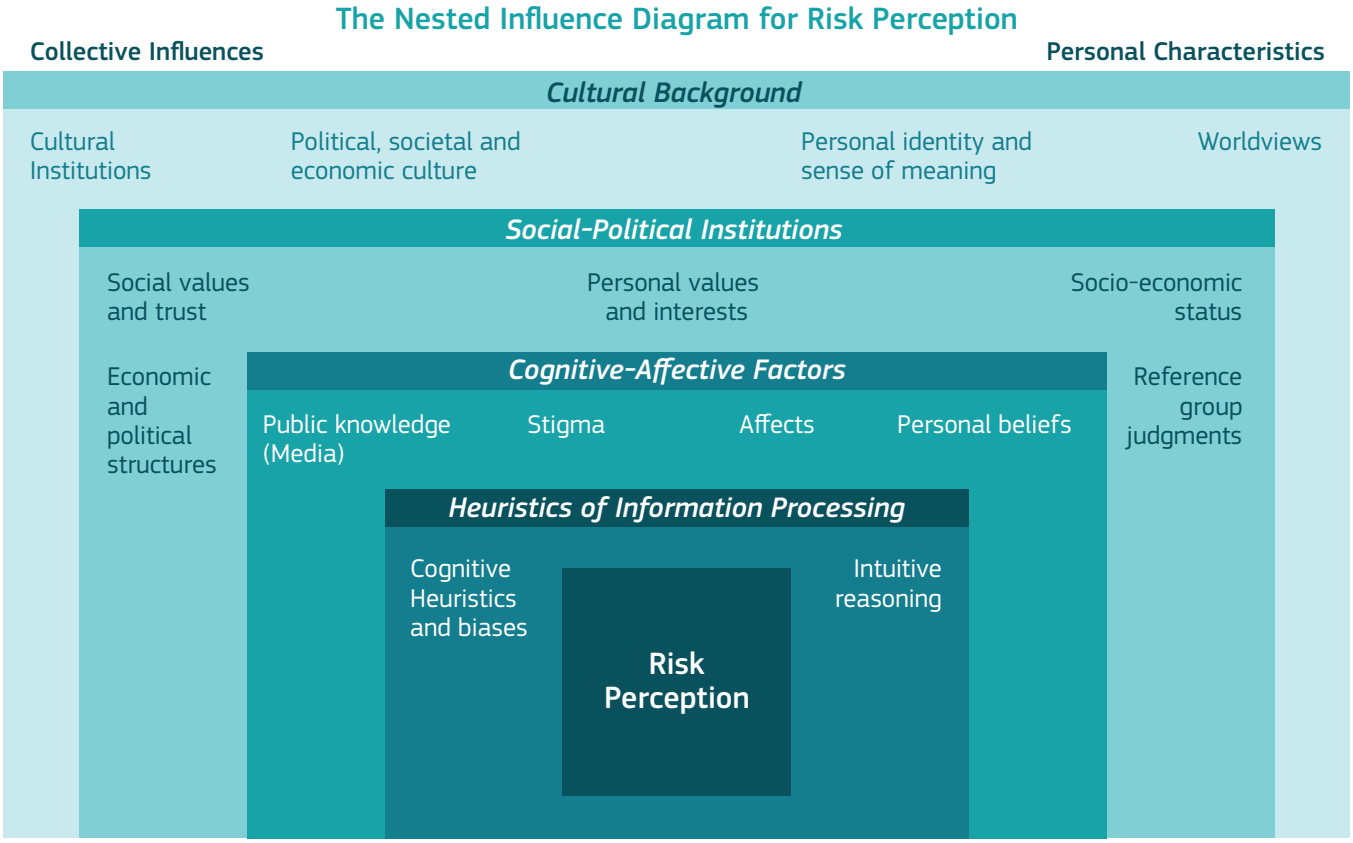

Figure 2. The multiple influences that interact to form risk perception (modified from Renn & Rohrmann, 2000b).

Research has also shown that Chinese individuals are significantly less risk-averse than individuals from Western countries when making financial decisions (Weber & Hsee, 1998). Furthermore, the evidence suggests that this stems from a difference in risk perception, rather than different attitudes to risk (Weber & Hsee, 1998; Bontempo, Bottom & Weber, 1997). In other words, it is not that Chinese people are happier taking bigger risks; it is that they perceive the risks as being smaller (Weber & Hsee, 1998; Bontempo, Bottom & Weber, 1997). Thus, policymakers must be careful not to assume that 'the public' will all act similarly in all situations, perceiving risks in a homogeneous manner (Pidgeon, 1998; Frewer, 2004).

Not only does cultural background influence risk perception, different demographic groups within a population have also been shown to perceive risk differently (Bickerstaff, 2004). One such example is the so-called 'white male effect' (Bickerstaff, 2004; Bier, 2001; Finucane *et al.*, 2000; Flynn, Slovic & Mertz, 1994). US research found that when compared with perceptions by women (of all races) or men from other racial groups, white males were more likely to perceive risks as being smaller (Bickerstaff, 2004; Bier, 2001; Finucane *et al.*, 2000; Flynn, Slovic & Mertz, 1994). Researchers hypothesise that this is because white males in the US are a wholly advantaged group, more likely to benefit from technological advances and less likely to face discrimination (Bickerstaff, 2004).

Olofsson & Rashid (2011) set out to examine whether the same effect held true in European countries. They showed that in Sweden people with foreign backgrounds did perceive risks as higher than native people, but there was no difference in risk perception between men and women. This may be because Sweden is a relatively gender-equal country, suggesting that social inequality in the US may be at the root of this effect.

However, research suggests that there are inherent biases which are ultimately common to us all, and only partly shaped by socio-cultural influences (Frewer, 2004; Gupta *et al.*, 2013; Renn & Rohrmann, 2000a). For example, it is known that perceptions of risk associated with nuclear power vary across countries. (European Commission, 2007, Slovic *et al.*2000). This may be because nuclear power – although seen as inherently more hazardous than more traditional power generation – has come to be seen as 'familiar' (and therefore safer) in countries where it has been established without serious incident for a long period. As a result the public in these countries is less fearful of a nuclear accident. Thus individuals in different countries may share the same inherent heuristic (i.e. they downplay familiar risks) however in some countries the risk of nuclear power has come to be seen as familiar, while in others it has not. (Schwartz & Bilsky, 1990; Hofstede, 2001).

2. Communicating risk

The extensive body of research on risk perception has helped to clarify our innate biases and provide insights into how cultural, social and emotional factors shape actual perception of risk. However, how can this knowledge be applied to the design and implementation of environment policy? One way is to develop better strategies for communicating risk – e.g. risks to health and to the environment the public usually under- or over-estimates (Frewer, 2004; Cope *et al.*, 2010; Bier, 2001).

2.1 The primary importance of trust

Trust in the communicator is a pivotal factor when conveying information about risk (Frewer, 2004; Cope *et al.*, 2010; Bier, 2001; Eiser *et al.*, 2012; Bickerstaff, 2004; Palenchar & Heath, 2007; Jones, Clark & Tripidaki, 2012). It is especially important when tackling the most difficult cases, where individuals have very little personal control over a risk or when a risk is considered dreaded or involuntary, for example, in the cases of nuclear accidents or pesticide contamination (Frewer, 2004; Cope *et al.*, 2010). It follows, then, that the choice of who should communicate information about risk is a crucial one.

Building public trust can be difficult and, once lost, difficult to regain. Studies have shown that events that destroy trust carry greater significance for people than those that enhance it (Bier, 2001). Perceived vested interests can quickly erode public trust (Frewer, 2004). In the case of genetic modification, for example, information from agri-business regarding the safety of genetically modified seeds would be undermined by public mistrust in the company, owing to the profits that the company stands to make from the technology (Siegrist, 2000). In fact, there is some evidence that information from an organisation or company which appears to promote a vested interest can lead to a tendency to believe the *opposite* of the original message (Frewer, 2004).

Research suggests that three main factors influence trust in an institution:

(i) competence (i.e. the knowledge and capability to manage the risk in question)

(ii) a history of being open and honest and acting in the public interest

(iii) sharing the same values as the individual (Bickerstaff, 2004; Cope *et al.*, 2010; Eiser *et al.*, 2012; Van Kleef *et al.*, 2007; Earle & Cvetkovich, 1996).

Bier (2001) gives a clear example of how openness can help build trust using the case of a chemical plant in Texas, US. A designated building was erected on the plant's site which members of the public could visit to access performance and regulatory reports. Initially this facility was heavily used, but visits declined over time, suggesting that this open access had helped to create an environment of trust (Bier, 2001).

The third factor, that the institution or risk manager shares the same values as the person judging the situation, may not always be straightforward to achieve, given the range of values held in a particular population. However, this does suggest that risk communication would be more effective if carried out at a local or regional level, because individuals may feel that a local representative is more likely to share their values.

2.2 Communicating uncertainty

In the past, some researchers have taken the view that informing the public of the uncertainties surrounding risk estimates would be destabilising for society. They believed that the public would not fully understand the uncertainties and that providing such information would undermine public trust in both institutions and in the science underpinning the risk estimates (Cope *et al.*, 2010; Frewer, 2004; van Dijk *et al.*, 2008). However, further research has demonstrated that the public are aware of uncertainty as an inherent part of risk management and that withholding data regarding uncertainty can actually reduce, rather than increase trust (Frewer, 2004; Van Kleef *et al.*, 2007).

There is some evidence that presenting uncertainty estimates can reassure those most likely to over-estimate risk. Kuhn (2000) showed that communicating uncertainties to individuals who were highly concerned about the environment reduced their perceptions of risk, suggesting that the acknowledgement of uncertainty reassured them and increased their trust in the communicator. However, further research has shown that this is far from being a universal effect. For example, it may vary between cultures; van Dijk *et al.* (2008) found that in Germany communicating uncertainty increased the perception that food risks were being handled well. However, in Norway and the UK information about uncertainties undermined people's trust in the risk management system (van Dijk *et al.*, 2008). Wiedemann *et al.*(2013) showed that giving people information about uncertainty and precautionary approaches to risks could leave the impression that science is either unable to deliver accurate assessments or that uncertainty is an indication of political bias.

Wiedemann (2011) noted that it is important to distinguish between communicating cause and effect (e.g. this chemical causes cancer), and communicating the uncertainty characterising this relationship (e.g. the uncertainty surrounding what dose and exactly how much the risk of cancer is increased). Uncertainty estimates can be seen by the public as a sign of sloppy or incomplete science (Wiedemann *et al.*, 2013), and communicators must make extra effort when reporting uncertainties to explain the meaning and limitations of the statistical models that have been used to express scientific uncertainty.

Communicating uncertainty has been shown to be more likely to have positive effects, such as better understanding and increased trust, if the data are presented alongside mitigation strategies. Van Dijk *et al.* (2008) demonstrated that consumers perceive food safety risks as better managed if they are given information on both uncertainties and regulatory enforcement at the same time. This has implications for institutions, which should not only be open about the uncertainties and unknowns, but also show that they have determined a process to deal with them.

One key point, which must be carefully and clearly communicated when discussing risk with the public, is the difference between uncertainty and variability (Cope *et al.*, 2010; Frewer, 2004; van Dijk *et al.*, 2008). Risk variability describes the variation of risk; for example, it may indicate how risk is actually different for different sections of the population. However, this is a known factor, not an 'uncertainty'. Uncertainty arises when knowledge is lacking or when the risk itself is unpredictable. It may reflect the need for more data or different types of analysis, or it may be a true reflection of the random and unpredictable nature of some risks (van Asselt & Renn, 2011). Uncertainty and variability can be easily confused and it is important that the public do not gain the false impression that knowledge of a risk is poor when in fact the data reflect known variations (van Dijk *et al.*, 2008).

2.3 The role of the media

There has been considerable debate over whether the media actually alters public perceptions of risk, or whether it merely reflects views already held by the public (Vilella-Vila & Costa-Font, 2008; Wahlberg & Sjoberg, 2000; Kitzinger, 1999; Sjoberg, 2001).

It has been argued that the media may influence risk perception by playing on our inherent biases. For example, constant reminders in the form of front-page news stories regarding a particular risk may mean that the risk springs easily to mind, thus increasing the sense of risk through the 'availability bias' (Wahlberg & Sjoberg, 2000).

However, reviewing the evidence, Wahlberg & Sjoberg (2000) note that media influence appears to be one factor among many, and it is by no means an overriding determinant (see also Sjoberg (2001)). They stress, for example, that although the media can influence the perception of general risk (e.g. how much a risk affects the whole population) it seems to have very little impact on perception of personal risk, which is a much more influential factor (Wahlberg & Sjoberg, 2000).

There is frustration among experts and risk managers about the bias in the media towards greater coverage of rare but 'sensational' risks (Wahlberg & Sjoberg, 2000; Kitzinger, 1999). For example, a death from an aeroplane accident has been estimated to be 6000 times more likely to make the front page of a newspaper than one from cancer, and the death toll due to smoking has received less coverage than that of nuclear power (Kitzinger, 1999).

However, the real problem may lie not so much in the fact that journalists provide the wrong information, but that they often present it out of context, possibly leading the public to jump to the wrong conclusions (Wahlberg & Sjoberg, 2000; Kitzinger,1999). For example a peer-reviewed study by Pearce, *et al.* (2012) led to a news headline stating that having CT scans as a child 'could make you three times as likely to develop leukaemia or brain cancer as an adult' (http://scienceblog.cancerresearchuk.org/2013/03/15/absolute-versus-relative-risk-making-sense-of-media-stories/). Numerically, the risks entailed one additional case of brain cancer and one of leukaemia for every 10 000 children given the scans, and the researchers in fact argued that the benefits that CT scans had as a diagnostic tool outweighed these risks.

Risk managers themselves may also be influenced by the availability bias. A possible reason for them to assume that the media always sensationalises material is because instances of 'media frenzy' are easier to bring to mind (Kitzinger, 1999). In contrast, when Cope *et al.* (2010) examined the views of the public on the media's role in communicating food risk they found that the public felt that they were able to discriminate between useful guidance and sensationalism. Researchers are now suggesting that social media could offer an unparalleled opportunity to improve risk communication, by providing instant, up-to-the-minute information, and by tapping into vast public networks as well as providing individuals with an opportunity to ask questions (Rutsaert *et al.*, 2013).

Risk communication as a dialogue

Risk communication should not be regarded as a one-way process. A system which enables an exchange between risk managers and the public will result in better, more widely supported policies. Below we detail some of the best practices that have been highlighted in the literature:

Before even beginning to design a risk communication campaign, policymakers must be clear on what its ultimate purpose will be. Is it designed to provide a forum for actual dialogue, where the public can contribute to decision making, for example? Is it to inform or is it to encourage behavioural change? It is important to clarify this, partly because these different goals will entail different strategies, but also because the public must not be misled. For example, if the campaign's purpose is to educate the public, but not to involve them in decision making, this must be made clear or trust will be eroded (Bier, 2001; Renn, 2014).

Who will contribute to the dialogue? Different stakeholder groups are likely to have different perceptions of risk as a result of different cultural backgrounds, for example, and it is important to know who the participants are (Cope *et al.*, 2010).

Identify the concerns of the stakeholders rather than simply giving them information that experts think is valuable (Cope *et al.*, 2010; Frewer, 2004).

Their concerns might not always be immediately obvious, for example, it may seem natural to assume that potential health effects are what concern the public most about GM food products, when in fact some individuals are more concerned about the power of large corporations (Gaskell *et al.*, 2004).

Trust in the communicator or risk manager is paramount. Participatory approaches to risk management can help with this, but the level of influence on any decision-making that participants will have must be made clear. If a lack of trust is identified, this should also be dealt with in an open way. Participants could be asked directly why they do not trust an institution and what, in their view, would help build a better relationship, for example (Bier, 2001; Löfstedt, 2003).

Misconceptions should be tackled head-on. One method to achieve this is to provide 'non-examples' – examples of what a term does not mean (Bier, 2001).

The media should not be regarded as an 'enemy', but as a channel which the public regards as a valuable source of information. Better engagement with the media could well help to improve the quality of information (Wahlberg & Sjoberg, 2000). Indeed, social media might provide a highly useful platform for dialogue (Rutsaert *et al.*, 2013).

3. Incorporating public risk perception into policy: towards an effective dialogue

In the past there has been debate about whether the public's perception of risk should be considered at all by policymakers: if the public's views differ from the experts only as a result of biases that lead to inaccuracies, then should policies be based only on the very best expert estimates? It has been suggested that any other course of action could be costly at best and may even put lives at risk (Cross, 1998).

However, risk management is not risk calculation. It is the balancing of risks and benefits, a process which ultimately requires value judgements, and neither individual scientific experts nor individual policymakers have any greater right to assign such values than any other member of society (Renn, 1998; Pidgeon, 1998; Frewer, 2004; Renn, 2001). As Pidgeon (1998) puts it, "technocracy should always be subordinate to democracy".

Public involvement may also increase trust in the institution, which is paramount to their perceptions of risk (Viklund, 2003). It could also prevent policy issues from being hampered by controversy and becoming too inflammatory for reasoned debate or political progress (Bickerstaff, 2004). Finally, it might also encourage public commitment to a course of action, possibly influencing behaviour (Pidgeon, 1998).

Once the importance of considering public risk perception as an integral part of policy making is established, a key question remains: is it enough that policymakers consult and engage in dialogue with the public before drawing up policies, or should the public actually participate in the decision making? If so, how?

Many different tools and models have been proposed to ensure effective public consultation and some approaches and case studies are explored here.

CASE STUDY 1:

Ebro Delta flood management

Raaijmakers, Krywkow & Veen (2008) developed a method to help governmental bodies develop strategies for complex risk issues while ensuring the involvement of local stakeholders, as part of the EU FLOODsite project (www.floodsite.net). They examined the case of the flood-prone Ebro Delta in Spain. This coastal area is dominated by agricultural land use but also encompasses settlements and nature conservation areas and is currently only protected from flooding by beaches.

The researchers used Spatial Multi-Criteria Analysis (SMCA) which has several steps. Firstly, they used the latest sea-level change projections, flood risk estimates and land use maps to develop future scenarios and estimate damage values. They then assumed one of two possible land use strategies, business as usual or a change in land use that required part of the area used for rice cultivation to be replaced by natural vegetation to provide flood defence.

Seven individuals representing local stakeholder interests, including tourism, agriculture and nature conservation, were interviewed to assess risk perceptions. Using SMCA, they then used a score of stakeholder 'worry' (a description of risk perception that feeds into issues of awareness and preparedness, see Figure 3) to weight the risks and benefits of alternative land use policies. In this way, the final scores produced by SMCA provided a measure of risk assessment incorporating stakeholder perceptions.

The results demonstrated that changing land use to form natural flood defences was clearly the best choice. Importantly, the interviews also revealed that the stakeholders perceived that preparedness was low. This informed future communication campaigns regarding flood responses.

This study illustrates the importance of public participation, not only as a process that can democratically assign values to the costs and benefits of different risk management strategies, but also as a way of allowing policymakers to understand whether there are areas where the public require more information or have different preferences to those assumed by policymakers.

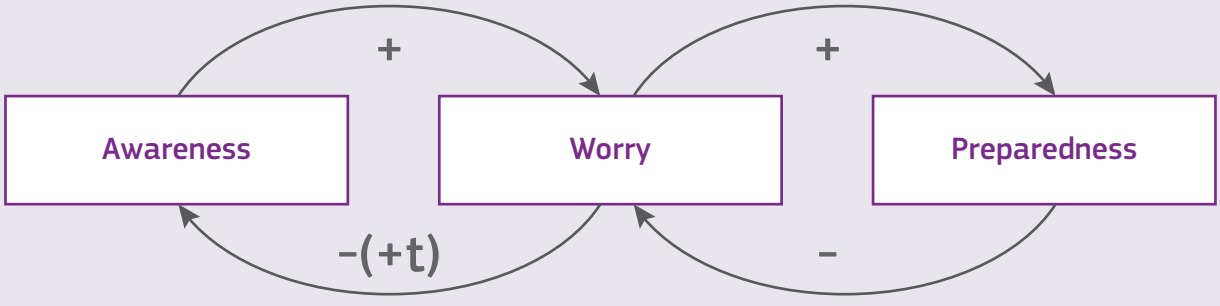

Figure 3. Stakeholder worry. Increased awareness can increase levels of worry, but this may then have a positive effect on level of preparation. Improved preparation in turn reduces worry. Over a longer time scale (+t) this may reduce awareness (Raaijmakers, Krywkow & Veen, 2008).

CASE STUDY 2:

THESEUS Decision Support System for coastal protection

Kane *et al.* (2014) proposed the use of a Decision Support System (DSS) as a starting point for risk communication and knowledge exchange, in a study conducted under the EU THESEUS coastal protection project (www.theseusproject.eu). Their DSS combined data on flood risk as well as economic, social and ecological impacts to aid decision making in coastal management.

The researchers used three stages of analysis to explore how communication and knowledge exchange could be fostered by the DSS. The first was based on interviews with stakeholders in three flood-prone areas in France (9 individuals), Spain (12 individuals) and Italy (11 individuals) and respondents were asked questions based on the findings of the risk assessment. The interviews were analysed for key themes, for example, for issues that respondents feel are relevant, or statements regarding which management options they feel are appropriate.

Scientific reports and risk assessments regarding coastal protection in the chosen areas were also analysed for themes, to provide information on the views of the scientists. Finally, to gain an idea of the individual standpoints of the experts, 10 scientists were interviewed in the same way as the stakeholders.

The results showed that, as expected, risk perceptions of local stakeholders were different from those of the scientists. However, the authors of the study note that these differences are not irreconcilable. The researchers suggest that the original DSS, rather than being a one-way system that fills a public 'knowledge gap', can provide a focal point for deliberation and learning, for both the public and scientists. Interviews and analyses, such as those conducted in this study, can be used to explore and integrate different views of what the important issues are, the causes of these risks and problems, what constitutes tolerable risk or the best balance of costs and benefits and finally, how this should be achieved.

Kane *et al.* highlight that it is particularly important to ensure that discussion and deliberation allow each group to consider and accept the best available science without feeling that their values have been threatened. This is in light of research by Kahan *et al.* (2012) which has shown that concern regarding climate change is not best explained by scientific knowledge, but rather by group values.

Conclusions

Scientific risk assessments are used to determine the best possible estimates of the myriad risks that humanity must face. However, understanding the way that the public perceives risk is key to answering the question: Is this a risk that we, as a society, feel is worth taking? The scientific estimate of the risk will not provide the answer.

Widespread consultation therefore plays an important role in effective risk management. Once the contributions of the experts, stakeholders, and members of the affected public have been recognised, a process of mutual understanding and constructive decision-making can develop. This process may not always result in exact alignment of technical risk assessments and public perceptions of risk, but experiences so far suggest that scientific expertise, stakeholder concerns and public perceptions can be reconciled if a serious attempt is made to integrate them (Rauschmayer & Wittmer, 2006, US National Research Council of the National Academies, 2008).

In conclusion, assessment, management, communication and participation are all vital components of a risk governance methodology that combines the best expertise with an inclusive approach towards addressing risk perceptions and stakeholder concerns.

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