
How the Media Report Scientific Risk and Uncertainty: A Review of the Literature

Teresa Ashe

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Preface

This study was written by Dr Teresa Ashe, with editorial assistance from James Painter. It has been financed by the Green Templeton College (GTC) Academic Initiatives Fund, which also provided the funds for a conference called 'Communicating Risk and Uncertainty', held in St Anne's College, Oxford University on 20 November 2012. This conference, which drew together academics, journalists, and practitioners from different fields, focused on the possible lessons about communicating risk and uncertainty from different disciplines, the specific area of communicating climate science, and the practice and challenges of reporting risk and uncertainty by journalists. A summary of what was presented and discussed can be found in the Appendix of this study.

The conference helped to inform a Reuters Institute (RISJ) book titled *Climate Change and the Media: Reporting Risk and Uncertainty*, which was published in September 2013. The book focuses on how the international media in six countries (Australia, France, India, Norway, the UK, and the USA) present risk and uncertainty around climate change. The book is the third to be published by the RISJ on climate change and the international media, following *Summoned by Science: Reporting Climate Change at Copenhagen and Beyond* (2010) and *Poles Apart: The International Reporting of Climate Scepticism* (2011).

The GTC Academic Initiatives Fund has previously funded in 2011 a study by Robert Picard and Minhee Yeo on the media and health reporting, titled *Medical and Health News and Information in the UK Media: The Current State of Knowledge*, and is currently funding an RISJ project 'The Changing Nature of Journalistic Work and its Implication' in conjunction with the Future of Work Programme at GTC.

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About the Author

Dr Teresa Ashe recently finished her doctoral research, 'The Politics of Climate Change: Power and Knowledge in Environmental Politics', at Birkbeck College, University of London. She works for the Open University as an Associate Lecturer. She recently published, with James Painter, an award-winning article 'Cross-National Comparison of the Presence of Climate Scepticism in the Print Media of Six Countries, 2007–2010' for the journal *Environmental Research Letters*. She is currently working to finish her first book and develop a post-doctoral research project on Soviet conceptualisations of climate during the Cold War.

List of Abbreviations

AR	Assessment Report (of the IPCC)
CRED	Center for Research on Environmental Decisions
GMO	Genetically Modified Organism
GTC	Green Templeton College
IGO	International Non-Governmental Organisation
IPCC	Intergovernmental Panel on Climate Change
MMR	Measles, mumps, and rubella
NGO	Non-Government Organisation
NHS	National Health Service
NICE	National Institute for Health and Clinical Excellence
RISJ	Reuters Institute for the Study of Journalism
UEA	University of East Anglia
WCRF	World Cancer Research Fund
WG	Working Group (of the IPCC)
WHO	World Health Organisation

Executive Summary

This study explores the presence of science-related news stories in the media, by focusing on the coverage of 'risk' and 'uncertainty' in environmental and health reporting. It first considers the use of these terms and their meanings in scientific and lay discourse, recognising the dual nature of concepts like risk, which are apprehended both statistically and affectively. It identifies, as a key preoccupation of the literature, the discussion of whether media reporting and lay discourse accurately reflect the expert calculation of risk. The report goes on to summarise research exploring how, when, and why scientific stories about risk and uncertainty are reported, outlining theoretical approaches to media reporting of environmental and health stories, the importance of 'newsworthiness' as an instance of tacit knowledge that dictates journalistic approaches, and the factors that lie behind the creation of news stories. The study then draws on existing research to analyse the difficulties for scientists working with journalists and vice versa, summarising current advice to both parties on how to facilitate accurate, but engaging, reporting of risk and uncertainty.

1. Introduction: Risk and Uncertainty in the Media

The investigation of risks is at once a scientific activity and an expression of culture. (Kasperson et al., 1988: 177)

As technological capacity develops, society increasingly faces challenges that cannot be understood without some appreciation of the science underpinning them, which makes media communication about scientific issues very important. As Corbett and Durfee (2004: 130) explain: '[f]or most citizens, knowledge about science comes largely through mass media, not through scientific publications or direct involvement in science'.

This study examines the media reporting of science-related news stories by concentrating on the usage of two scientific terms: 'risk' and 'uncertainty'. Both of these concepts are scientifically important, yet difficult for the non-scientists to grasp and, in both cases, the way the public understands these terms will impact on its responses to perceived threats. This study examines how scientific information related to these two concepts is communicated through the media and understood by the lay public, examining the existing literature to provide a survey of how researchers have tackled the topic and what is currently known.

Definitions

To focus on 'risk' and 'uncertainty' would seem, at first glance, to be a relatively simple, well-defined remit, concentrating on the use of two scientific concepts in media discussion. However, both terms prove elusive to define, even within scientific discourse.

An initial attempt to define 'risk' will often elicit the idea that it is quantitative (the likelihood of an event (Spiegelhalter, 2012a: see Appendix, p. 35), or 'a function of both the probability of the event's occurrence and the magnitude of the event's impact' (Hulme, 2009: 181). Yet Nick Pidgeon (2012: see Appendix, p. 37) points out that there is no *single* definition of risk within academic literature or amongst the regulatory frameworks that manage risk in different areas of life.

'Uncertainty' is also an ambiguous term (Pielke, 2007: ch. 5), used differently in a number of contexts and academic disciplines, which can mean anything from 'we have no knowledge' (in public parlance) to the fundamental uncertainty of quantum mechanics. In most science and engineering, 'uncertainty' means '*that in a particular situation more than one outcome is consistent with our expectations*' and it is expressed by giving a margin for error with every measurement (Pielke, 2007: 55). This usually takes the form of a range (shown by error bars on a graph or with \pm), which is calculated so that there is a particular likelihood of the true value being within that range: a 95% confidence interval is calculated 'so that there is only a 5 percent chance that the true value of the variable being estimated lies outside those bounds' (LaFountain, 2004: 50).

The two terms are also sometimes defined in relation to each other, as covering separate, but associated kinds of unknowing in science. Spiegelhalter (2012a: see Appendix, p. 35) speaks of 'risk' as quantitative (e.g. a one in ten likelihood of harm) and 'uncertainty' as qualitative, because it acknowledges doubt or disagreement about the extent of the risk of an event occurring (e.g. a risk of harm that we cannot put numbers on). Andy Stirling (2001) models

'risk' similarly as a feature of areas where we have good scientific basis for assigning probabilities (e.g. knowing that one of ten guns is loaded) and where we anticipate well-defined outcomes (the traditional definition of probability times magnitude), but uses 'uncertainty' to discuss areas where we have a well-defined sense of the outcomes anticipated, but little basis for assigning probabilities (e.g. not knowing how many of the ten guns might be loaded). Yet Pielke (2007: 55) distinguishes situations in which 'uncertainty' means 'ignorance' 'from situations of "risk" in which we know the probability distribution of possible outcomes, such as with the roll of a die'. A brief survey of the literature therefore, makes clear that there are many nuances to the way these two terms are defined and used.

A further definitional complication in the discussion of risk is raised by Mary Douglas and Aaron Wildavsky (1983) in their work on the Cultural Theory of Risk, which emphasises subjectivity, because recognition of risk inherently involves a value judgement. 'Hazards or behaviours which threaten valued assets or lifestyles will be viewed by a society or culture as risky. But since each culture holds different assets and lifestyles to be of value, they will assign varying levels of importance to different risks' (Hulme, 2009: 185).

The sometimes acrimonious resistance this perspective generates can be difficult to understand without exploring some of the tacit assumptions about how and why we discuss risk and uncertainty. There are those who make an impassioned case for risk to be understood solely as an objective concept (Hinde, 1997), largely on the normative premise that only then can society hope to make rational choices about appropriate responses. This perspective often views any discussion of the subjective or socio-cultural elements of risk as a way of undermining the epistemic authority of scientific knowledge. Often this is far from the intentions of the proponents of cultural theories of risk, who believe the myth of objectivity is part of what makes effective risk and uncertainty communication so fraught with difficulty.

Existing Literature on the Reporting of Risk and Uncertainty

While there are few research articles that expressly deal with the reporting of 'uncertainty', there are a modest number looking at risk and the media, which often touch on the question of uncertainty. On risk, Jenny Kitzinger (1999) offers a useful review, which emphasises the diversity of themes, approaches, and studies that have been used to tackle this topic. On the other hand, uncertainty tends to be the focus of research only in relation to climate change, where it has become a key point of contention between those who advocate action and those who believe 'uncertainty' means that action should not be taken. Corbett and Durfee (2004) offer a good literature review of the work being done on this topic, but as a general scientific term, 'uncertainty' has been of much less interest to media researchers.

Work on the origin of the concept of risk may help explain why this term has attracted relatively more interest from the media and its scholars. Mairal (2011) notes that the term became important in discussion of commercial losses, maritime disasters, and epidemics or catastrophes, after becoming associated with the mathematical notion of probability in the fifteenth century. Previously it had meant simply 'harm' or 'discord', but as it became a more actuarial concept, it took on an important narrative purpose also:

we may affirm that risk is an expert concept that nonetheless crossed over into the cultural sphere through narrative, which spread the idea among a progressively wider public in a process that began in the broadsheets, gazettes, newspapers and journals of the eighteenth century and still goes on today in the modern mass media. (Mairal, 2011: 65)

Risk has therefore had an important role within public and commercial narratives of harm in uncertain circumstances for several centuries and is perhaps a natural focus for the media and its scholars. The mutually influential nexus of media, science, policy, and public opinion around contemporary health and environmental issues ensures that this focus continues today.

These scholars have often taken as a key question whether the media response to risk is proportional, thereby fostering a reliable assessment of risk in the public sphere. It is a question that tacitly at least, favours the objective, rather than the cultural, understanding of risk: it presumes risk to be objective and then evaluates media reporting against the paradigm of formal professional risk assessment. High-quality reporting is viewed as important, because poor risk reporting may foster poorly informed public perception of risk, which may lead to misallocations of resources as authorities mitigate *concern* about risk rather than actual risk. Ropeik (2012: 1222) calls this the 'perception gap': 'we are sometimes more afraid than the evidence suggests we need to be, and sometimes not as afraid as the evidence suggests we ought to be'.

This argument for high-quality risk reporting is most appreciable in the field of health and in reporting medical research. Studies like LaFountain's (2004) demonstrate that the media are an important, but not always instructive, source of risk information, particularly in their tendency to give more coverage to alarmist perspectives than scientists deem proportional. Research evaluating risk reporting finds many instances of poor practice in relating news about health matters, including LaFountain's (2004) work on the reporting of concerns about electromagnetic fields, the effect of chemical facilities on breast cancer rates, and the health effects of chlorine; Boyce's (2007) work on the reporting of concerns about the measles, mumps, and rubella (MMR) vaccine; Canales et al. (2008) on hormone replacement therapy; Harrabin et al. (2003) on appropriate coverage of diseases; Riesch and Spiegelhalter (2011) on middle-class drinking and the cancer risk of bacon sandwiches; and Spiegelhalter (2012b) on drinking in pregnancy. Websites like <http://understandinguncertainty.org> (managed by David Spiegelhalter) and *Behind the Headlines* (run by the NHS) also monitor health-related news stories on a regular basis, explaining the science behind the stories and assessing how accurately they are reported.

Yet there are also studies which challenge the impression that the media's treatment of risk is generally inaccurate and alarmist. Klaidman (1990) argues that, on the contrary, scientific reporting should and, in general, does reflect what he calls the 'reasonable reader' criteria, which allow for newsworthy stories without outright misleading of the public. Kitzinger (1999: 56) also identifies research that avoids the alarmist stereotype and other researchers argue that, when poor health reporting does occur, it is often the fault of the scientists' press release and not the journalists (Riesch and Spiegelhalter, 2011; Spiegelhalter, 2012a). McCapra (2005) even suggests that

journalists sometimes succeed in digging an accurate scientific story out of a scientific report when the press release has been misleading and sensationalist.

There is also the problem that professional risk communicators may find themselves under similar pressures. The 'prevention paradox', for example, occurs because it is hard to frame information in ways that high-risk individuals will relate to, thus 'it is more rational, in the sense of maximising overall benefit to the population, for a public health body to persuade a large number of low-risk individuals to change their behaviour slightly, than to get the few high-risk individuals to change their behaviour substantively' (Riesch and Spiegelhalter, 2011: 61).

Ropeik also challenges the assumption of alarmist reporting, claiming it is 'simplistic and unproductive, and ignores or dismisses the large body of research that finds that the perception of risk is not, and can never be, perfectly rational' (Ropeik, 2012: 1225). His work is important because it explicitly addresses the tension between the objective and cultural understandings of risk, by making clear that human beings are not rational calculating machines, but apprehend risk based on 'a mix of the facts and the way those facts feel' (Ropeik, 2012: 1223). This makes the media's 'alarmism' a result of the way our brains process risk, not a cause of it. Drawing on neuroscientific, psychological, and sociological insights into the processing of risk information, he argues that, however quantifiable and knowable a risk, the way we perceive those facts will be subjective and lead to varying perspectives on that risk.

Indeed, if the media routinely sensationalise, Ropeik argues, then it is difficult to see how they can be responsible for perception gaps that allow us to be *less* afraid than the evidence warrants. Ropeik argues that we should be aware of and study the perception gap, because being more or less afraid than the evidence warrants leads individuals to make poor lifestyle choices, causes stress-related health problems, and creates sub-optimal policy responses as we invest in mitigating worry rather than mitigating the actual risk of harm. He argues that an awareness of this perception gap should be built into risk communication:

The morbidity and mortality effects of the Perception Gap regarding [for example] vaccines can be factored into the cost-benefit analysis of policies to encourage, or mandate, vaccination. The harm to public health from continued fear of vaccines can be discreetly considered in lawmaking and the writing of regulations, and in the development of tax and insurance and other economic policies to encourage or discourage certain behaviours. (Ropeik, 2012: 1225)

2. The Drivers of Media Coverage

[I]t seems to me that the important questions are not do the media 'play up' or 'play down' risk—but which risks attract attention, how, when, why and under what conditions. (Kitzinger, 1999: 62)

Kitzinger makes clear that 'any summary of research findings [on the topic of risk reporting] has to be approached with caution . . . the variety of findings from different case studies suggests that how a message or "signal" is transformed or "amplified" by the media is a complex process that does not follow one simple set of rules' (Kitzinger, 1999: 62). However, she does offer an extensive list of 're-occurring findings and insightful suggestions evident in the research' that, coupled with subsequent work, allow us to address the questions of: *how* risk stories and uncertainty are reported; *when* stories about risk and uncertainty are reported; and *why* stories about risk and uncertainty are adopted by journalists.

How are risk and uncertainty reported?

Researchers have generated and used a number of methodological approaches, which aim to explain *how* risk and uncertainty are reported, particularly in relation to environmental issues. Although there is diversity within them, each focuses on the *way* that stories are told: how the story's signals and presentation encourage a particular way of fitting new information into existing worldviews. These approaches have included the following:

- Anthony Downs's (1972) 'issue attention cycle', which was developed to analyse environmental media stories, charting an issue's rise to prominence as a potentially solvable problem, and its subsequent decline, as initial steps are taken and it becomes clear how costly and difficult further action would be.
- Research based on 'discourse analytical' approaches, such as John Dryzek's (2005) or Maarten Hajer's (1995), which identify the storylines crafted around environmental issues and unpack the assumptions and implications of these storylines.
- Cultural theory's 'circuits of culture' model, which argues that 'Media communications may be theorized as a circuit of cultural forms through which meanings are encoded by specialist groups of producers and decoded in many different ways by the groups who constitute the audiences for those products' (Burgess, 1990, 139–40).
- Research by some communications theorists, who utilise the metaphor of electronically transmitted messages, where 'amplification denotes the process of intensifying or attenuating signals during the transmission of information from an information source, to intermediate transmitters, and finally to a receiver' (Kasperson et al. 1988: 180).
- 'Frames', which are understood as 'an inherent part of cognition, employed to contextualize and organize the dynamic swirl of issues, events and occurrences' (Boykoff, 2008: 555) or as 'cognitive tools to order information' (Moser and Dilling, 2004: 36).

Each of these approaches attempts to illuminate how risk stories are told in the media and emphasises that journalists make choices about whether and how to present new information.

The last approach, looking at the framing of media reporting on risk, is a particularly good example, because it emphasises that there are many options available to journalists and no culturally neutral way of presenting information. Indeed, the language of framing can often be used in conjunction with other approaches mentioned above. Defined as 'the setting of an issue within an appropriate context to achieve a desired interpretation or perspective' (Center for Research on Environmental Decisions (CRED), 2009: 6), frames are viewed as an inevitable part of conveying information and can be explored by discourse analysis or by those interested in the amplification or attenuation of particular messages. Framings will be used by readers or listeners to organise ideas, understand why an issue might be problematic, and condense complex information into bite-sized chunks. CRED makes it clear that it is impossible *not* to offer some kind of frame when discussing a topic and offers guidelines and advice for helping to frame information in ways that maximise comprehension.

As a methodology, framing allows researchers to explore how issues are being presented in the media and consider the factors that influence journalistic constructions of these frames (personal beliefs, organisational outlook, and sources, for example). Olausson (2009) for example, uses a framing approach to look at tensions between national news agendas and transnational environmental risks in Sweden, finding an unwillingness 'to display any kind of scientific uncertainty that would undermine the demand for collective action' on the problem (Olausson, 2009: 421). Zehr (2000) also uses a framing approach to look at the role of uncertainty in the media presentations of climate change, viewing uncertainty as 'an important "frame" through which the science of climate change was presented in the press' (Zehr, 2000: 88–9).

Indeed, climate change reporting is particularly amenable to this approach and there is a wealth of research on how different narratives underpin or frame the reporting of risk and uncertainty on this topic: McComas and Shanahan (1999) analyse the narratives that help drive its issue attention cycle; Weingart et al. (2000) look at discourses of climate change in the German media between 1975 and 1995; Doulton and Brown (2009: 191) identify discourses with regard to climate change and development identifiable 'in UK "quality" newspapers between 1997 and 2007'; Carvalho and Burgess (2005) use a cultural circuits approach to explore media constructions of climate change risk; and Morton et al. (2011: 103) draw on classic framing research, which considers the psychological impact of different ways of presenting information (Tversky and Kahneman, 1981; Meyerowitz and Chaiken, 1987), to examine whether framing can overcome the difference between scientists and public approaches to uncertainty.

However, one of the great strengths of the framing approach is that it does not presume that messages are transmitted intact from journalist to audience. As with the other approaches mentioned earlier, framing analysis recognises that there is fluidity to the meanings that individuals may take from a particular presentation of a new story, because each member of the audience will view it from a different perspective. Important work on how readers or viewers actually interpret and experience the messages of media

communication is being done by researchers like Emily Shuckburgh (see Appendix, p. 38) and Corbett and Durfee (2004), who look at public responses to different presentations of the same facts.

A useful concept in thinking about public engagement with the media is that of a 'mental model', which 'represents a person's thought process for how something works . . . Mental models, which are based on often-incomplete facts, past experiences, and even intuitive perceptions, help shape actions and behavior, influence what people pay attention to in complicated situations, and define how people approach and solve problems' (CRED, 2009: 3). A mental model's approach to risk communication, to simplify:

compares what experts know about an issue and what they think people need to know, with what people actually do know and want to know, and what they may have wrong. That allows the communication program to target the specific gaps between the expert and public mental models of the issue that need to be closed. Mental modelling also advocates testing messages and refining them based on audience feedback. It is a two-way process of risk communication, unlike largely failed efforts in which the experts decide what people need to know, without asking them. (Ropeik, 2012: 1225)

An important element of the mental model approach is the idea of 'confirmation bias', which occurs when people only assimilate information that is already compatible with their mental model. A similar insight is generated by the Theory of Cultural Cognition, which argues that human beings evaluate factual information from socially situated positions that affect how we sift evidence and present arguments. The importance of collective decision-making for human survival means that we will filter our beliefs about the world, even about scientific information, through the perspective of the social groups with which we most closely associate ourselves.

A methodology, such as framing, which concentrates on how news stories about environmental problems are presented, can also be a useful way to approach the study of medical reporting. Riesch and Spiegelhalter (2011), for example, show how news stories about health can be situated within familiar storylines such as the excesses of the nanny-state or the inhumanity of putting cost before suffering. Often these storylines can take what is ostensibly a health issue and allow it to become a more diffuse anti-technology or environmental issue, making the line between health and environmental news stories difficult to discern. Discussion of reporting on GMOs in Burgess (2009) for example, shows how risk campaigning transcended the scientific arguments about risk so that 'coverage was led by political, environmental and even lifestyle journalists rather than science reporters, indicating the extent to which it was redefined from being a scientific/technological issue to one of consumer and environmental risk' (Burgess, 2009: 6).

Research addressing how news stories report risk and uncertainty is therefore able to offer theoretical answers, which emphasise the plurality of possible presentations and understandings available to communicators. It is also able to emphasise that different readers will take different things from a news story and integrate new information into their worldviews in different ways. Through these theoretical answers, methodological approaches are taken which can generate insight into how particular stories (environmental

risk, climate change, health studies, etc.) are reported and we can begin to explore when and why particular frames are employed; something we explore in the following sections.

When are stories about risk and uncertainty reported?

Closely allied to the question of *how* a story is reported, studies have also generated information about *when* a news story about risk or uncertainty is reported. A wide range of factors attributable to general journalistic culture provide an initial answer. Kitzinger (1999), for example, notes that journalists will be more likely to report on stories which are located in well-known or easily accessible places. If a journalist can reach a news story easily, or knows that many people will feel a connection with the place it is happening (capital city, well-known nature park), then they are more likely to report on it. Another example is the rule that a story is more likely to be reported if other media outlets are covering it, although a particular media outlet may unilaterally take up a risk issue as a pet topic, which can be returned to whenever news is slow or it is felt the media outlet needs to define their brand more clearly (Burgess, 2009). Other examples may include the need to find stories that will fit particular media formats, such as environmental, science, or women's health pages.

Fundamentally, however, the most important factor in determining *when* a story about risk or uncertainty will receive news coverage is 'newsworthiness'. This is an elusive concept, but occurs time and time again in discussion of this question. As journalists continually make clear, significant social issues are not automatically 'newsworthy': 'an issue may be important as you say . . . but that doesn't make it news' (media participant in group work on risk, 2003, quoted in Smith, 2005: 1474). To be worthy of becoming news, a story must help the journalist meet their obligations to please their customers, constantly provide *new* material, gain editorial and institutional approval, and react in a timely way to contemporary events.

This can mean some prospective news stories are automatically more difficult to justify than others. While some risks are sudden, immediate, and temporary (a volcanic eruption, ash clouds, a quickly contained epidemic, etc.) many issues of risk are 'creeping' issues, or ongoing, slow-burn stories like the spread of AIDS or human-induced environmental changes. These become difficult to fit with the idea of newsworthiness, because for slow-burn issues to warrant continuous news coverage requires continuous fresh angles on a story. Journalists say that hefty reports from reputable official bodies can act as landmark events, which offer the opportunity to draw together diffuse information on a topic such as world poverty or climate change (see Harvey and Kelland in the Appendix, p. 47). Reports from the Intergovernmental Panel on Climate Change (IPCC) or the World Health Organisation (WHO) are therefore useful in giving journalists a hook to hang their stories on. These issues may be constantly relevant, but too abstract to allow steady coverage without such hooks.

In health reporting too, there are some risks that are simply not as interesting to journalists as others. Kitzinger (1999) notes that harm is newsworthy, whereas the finding that a suspected risk factor actually brings benefits or is benign is not, except when such findings contradict received wisdom. She also notes that journalists prefer risks that harm many at once, rather than risks which are cumulative; unusual risks, rather than common

ones; stories which can be linked to a human face; stories with clear victims; stories in which the victim is famous or notable; events rather than processes; and immediate rather than long-term or continuous threat processes. Harrabin et al. (2003) demonstrate that media coverage of health issues does not reflect the actual risks of suffering from a particular health problem. They trace the lack of proportionality to reporters' and editors' commitment to 'news values'. In health too, newsworthiness can be exhausted swiftly (story fatigue) if journalists run out of new angles, even while the risk is still there.

'Newsworthiness' is, essentially, a catch-all term for conveying the myriad criteria, explicit and implicit, that journalists and editors use to make decisions about their choice of stories. It is a kind of tacit knowledge, and therefore the elements that make a story newsworthy will differ slightly from editor to editor and evolve over time. On the other hand, some researchers argue there are identifiable factors which can make a story about risk more likely to receive media attention and these help us give shape to the concept of 'newsworthiness'. For example, Nick Pidgeon (2012, see Appendix, p. 37), whose work examines media coverage of climate change, argues that risk stories are more likely to attract the attention of journalists if they involve some of the following elements:

- questions of blame
- alleged secrets and cover-ups
- human interest
- links with high-profile issues/persons
- conflict
- an event can be presented as signalling a wider trend
- many people exposed
- strong visual impact
- links to sex or crime

These factors are thought to be newsworthy, heightening public interest and making a story worth reporting. Research into why these factors are found to be newsworthy takes us in the direction of psychological work, which, like Ropeik (2012), starts to look at how human beings process information about risk. These elements of newsworthiness are also helpful for journalists as they allow them to access recognisable frames or narrative structures that help people understand and care about the stories: 'this is another example of government interference in individual choices' or 'this is another way in which the government is impotent in the face of business interests'. In this way newsworthiness and framing can fold into each other.

We are thus able to conclude that news stories about risk and uncertainty are reported when journalists find they harmonise with their own concept of newsworthiness. The criteria will differ from journalist to journalist, editor to editor, and media outlet to media outlet, with each negotiating their own understanding of their role. The particular elements that each will believe necessary in a newsworthy story will depend on a subjective judgment about what the reader, the news institution, the funders, and the editors want. It will be based on preconceptions about what grabs audience attention and on learned institutional practice.

Why are stories about risk and uncertainty reported?

Journalists, as Kitzinger (1999) makes clear, are themselves culturally, politically, and geographically situated individuals, who will be attracted to news stories that they personally judge to be important or a good fit with their editors' or organisation's preferences. On the other hand, those providing the stories will have their own interests and ideas about how reporting should occur.

Picard and Yeo (2011), in discussing health reporting, point out that journalists, scientists, and medical practitioners each have different goals, with researchers wanting to improve public understanding of science, practitioners emphasising the improvement of healthy behaviours, and media professionals wanting 'coverage that informs the public about medical and health advances and debates, protects the public against risks, and exposes inefficiencies or corruption in medical and health institutions or delivery' (Picard and Yeo, 2011: 3).

This can mean that particular goals in the dissemination of information can affect the way information is framed. The 'prevention paradox', for example, occurs because it is hard to frame information in ways that high-risk individuals will relate to, thus 'it is more rational, in the sense of maximising overall benefit to the population, for a public health body to persuade a large number of low-risk individuals to change their behaviour slightly, than to get the few high-risk individuals to change their behaviour substantively' (Riesch and Spiegelhalter, 2011: 61).

Different communities with different interests are also discernible in the field of environmental risk, where media owners, editors, journalists, governments, scientific bodies, researchers, international organisations, lobby groups, companies, and environmentalist NGOs maintain or pursue different priorities and agendas for media coverage. The interaction between these groups helps determine whether a story gets covered or not.

Joe Smith's (2005) research 'throws light on media decision making by concentrating on key moments in the process of mediation wherein the science, policy and politics of climate change are transformed into the broadcast stories that do so much work in public discourses of environmental risk' (Smith, 2005: 1471). His work on the broadcast media is important because it offers insight into the perspectives of different groups involved in reporting by bringing together senior media decision-makers and academics in the field of environmental change.

This research gives us insights into how the organisational and working practices of the media create particular choices about how and when risk stories will be covered:

there are some common approaches to the way stories are told, and some more or less hidden but significant causes and consequences of this. Respected news craft lies in the choreography of words and images, where pictures make the script both memorable and legitimate. Editorial decision makers manage the kind of stories and the rate of flow around a particular topic. (Smith, 2005: 1476)

Smith finds, for example, that in the British context environmental NGOs play an important role as a media source on environmental stories. Scientists within the workshops often bemoaned this tendency, yet themselves showed

much less understanding of the media's needs with regards to newsworthy stories. NGOs, Smith argues, act as issue entrepreneurs by staging photogenic protests or timing reports to maximise media coverage. '[A]dept NGO media handlers have designed actions with a close and trained eye on winning victories in the discursive struggle played out in the media over an issue such as climate change' (Smith, 2005: 1473). While NGOs rely on risk as a key selling point of their perspective on a story, they 'do not work with rigid metrics of risk; their claims are fluid across time and space, allowing them to be opportunistic and innovative in ways that satisfy news needs and practices' (Smith, 2005: 1473).

On the other hand, some risk stories lead to journalistic overreliance on official sources (Kitzinger, 1999), which have the resources and PR teams to ensure their press releases are accessible to journalists and released at the opportune moment. These claims-makers can also create the opportunity for a newsworthy story because policy events are themselves newsworthy moments, so official bodies can ensure their perspectives accompany stories about new policy. In the case of a particular risk event, such as an epidemic, journalists will turn to official bodies with responsibility in the right area. This can mean that official sources, or whichever sources have the right resources, can 'manage' a risk story to keep it on the media agenda by providing new perspectives on it or help it slide off. Also, newspapers are often more comfortable reporting controversial claims if these are backed by an official source.

Alternatively, risk events can lead journalists to reject official sources or begin to question them as the story moves on to look for blame or motives behind actors' pronouncements. Journalists, as Sandman (1988) points out, prefer strong viewpoints so that they can create a dramatic tension between different views, making them likely to favour extreme commentators over moderate official sources. This can exacerbate the problem of 'false balance' as journalists give equal attention to a passionate advocate of a minority position and a comparatively dispassionate representative of the majority position. Official organisations may also find themselves bureaucratically hampered in responding to risk events or sidelined in favour of more visible, more accessible, or more human sources.

Another element of the bureaucratic functioning of media outlets, as emphasised by Dispensa and Brulle (2003: 75, 83), is that many are, themselves, 'big business' operations with a tendency to protect the establishment, identify with national vested interests, and ensure that their institutions' advertisers and corporate owners are happy with their reporting: 'In essence, the media's main order of business is manufacturing attention and delivering it to advertisers' (Dispensa and Brulle, 2003: 84). This can mean picking stories that will appeal to the kind of moneyed and powerful readers that advertisers want to communicate with or it can mean abiding by the contractual obligations on how to cover stories, which companies like Proctor & Gamble include in their advertising contracts. The mechanics of the journalism industry are explored by Nick Davies, in his (2009) book, *Flat Earth News*.

Finally, there are also variations in the motivations of sources for going to the media, which affect how an issue is covered. Some actors may see the media as a route to attracting the attention of policy-makers or as a way of whistle-blowing, others will see it as a way to communicate with the general

public and recruit adherents to their own way of thinking. An individual with a good grasp of what the media need from a story may be able to draw attention to a risk that has hitherto been of no interest. The motivation of sources is therefore an important element in understanding why stories might be reported at particular times and in particular ways.

Existing literature can therefore tell us much about *how* media reporting occurs, offering numerous theoretical models for understanding coverage and generating insights about particular case studies through application of these models. Studies have also helped explain *when* a story is likely to be reported by considering the criteria of 'newsworthiness', which journalists use to make choices about whether a story will be covered or not. Finally, we have seen how research can help us understand *why* news stories come to be covered or ignored by the media, through an assessment of the roles different sources play in presenting the media with potential stories. Different goals, resources, and motivations on the part of sources will help explain why a story reaches public discourse in the form that it does.

3. The Challenges for Scientists

Often research into the reporting of risk and uncertainty focuses on the challenges faced by different actors and is motivated by the desire to improve reporting. In this section we look at work focusing on the role of scientists and scientific communication through the media.

Scientists' concerns

In considering the attitude of scientists to involvement in environmental reporting, Smith (2005) found that many are reluctant to participate in public discussion. They not only fear that simplifying their own highly complex research for a lay audience will mean losing credibility within the scientific community, but also that they will find what they say is misrepresented: 'the two minutes you'll give to an issue I've given ten years to trying to figure out will only make the public more confused – not less' (Smith, 2005: 1474).

Recent events in Italy when six scientists and an official were charged with manslaughter have confirmed how dangerous it can be for scientists to have their words on risk and uncertainty taken out of context (Connor, 2012; Spiegelhalter, 2012c). Their pronouncements on the likelihood of an earthquake in L'Aquila in 2009 were reported by local authorities and media in a way that minimised public perceptions of risk and then, when the earthquake took place, they were blamed for the loss of life and damage to property. The episode led to reflections on the legal position of scientific advisers (Aspinall, 2011), the dangers of letting clichés about journalistic reporting reassuring one prematurely (Spiegelhalter, 2012a; see Appendix, p. 35), and advice on how to safely engage with the media on 'low-probability high-impact events' (Spiegelhalter, 2012d).

Despite such concerns, Smith (2009) discovered that many scientists feel a social obligation to attempt to contribute to good media coverage of their areas and see this as an important social responsibility attendant on their position.

Advice for Scientists

To assist in meeting the challenges scientists face in engaging with the media, there are some excellent practical guides to effective science communication (CRED, 2009; Futerra, n.d., Ward, n.d., American Association for the Advancement of Science, 2012; Sandman, 1988). These offer advice on how to get scientific findings across more clearly and try to ensure that scientists understand the logic of the media as to how sources will be used, the misconceptions that journalists or members of the public may already have, the kinds of frames that will help convey information meaningfully, and the kind of metaphors and graphics that can help people understanding statistical information about risk.

Research makes clear that a key difficulty in science communication is the very divergent perspectives held by members of the scientific community and those outside it. For the lay public, 'science' itself may be conceived of as a body of established knowledge or a collection of facts, but for those involved in scientific activity, something that is established enough to be considered a 'fact' ceases to be of interest (Rapley, 2012, see Appendix, p. 42). It is uncertainty which characterises and is integral to scientific research.

Because of this conception of science, the public ascribe very different meanings to words like ‘uncertainty’ and ‘risk’. To the public, ‘risk’ can often mean a negligible ‘low probability event’, whilst talk of ‘uncertainty’ can be interpreted as ‘not knowing’ (CRED, 2009: 27). Recognising the need to communicate the intrinsic uncertainties of science itself better is therefore an important part of better science communication (Willettts, quoted in Spiegelhalter 2012a: see Appendix, p. 35).

The communicating of information about the IPCC Assessment Reports offers a particularly good example of conscious attempts to improve science communication to the lay public. When the organisation was first created in 1988 it became clear that the way ‘risk’ and ‘uncertainty’ were communicated would have to be standardised (Painter, 2013: 18ff.). A set of linguistic indicators was organised, which corresponded to a numerical table of probabilities combined with a grading of confidence in those probabilities. In this way, it was hoped that reliable communication of relative risk and uncertainty would be accessible to lay persons, policy-makers, and journalists, but the approach has subsequently attracted criticism from researchers like Budescu et al. (2009: 299), who note that the ‘judgment literature indicates that there are large differences in the way people understand . . . phrases [like “very likely”], and that their use may lead to confusion and errors in communication’.

Uncertainty is a particularly difficult area for scientists, because ‘it is always difficult to convey scientific uncertainty without giving the impression that nothing useful is known, but overstating scientific certainties can be more dangerous’ (Aspinall, 2011). So scientists have to guard against erroneous inference, whether this exaggerates or underestimates the state of knowledge. Challenges for scientists include conveying relatively complex statistical mathematics to lay persons *and* ensuring that their language, and the representation of their results, is calibrated to communicate with non-specialists. Spiegelhalter (2012a) advocates reporting the chance of a statement being wrong, rather than giving just the chance of the event happening and also making clear the areas of certainty as well as of uncertainty.

Yet, the public also have a tendency to view uncertainty as denoting areas of ignorance, akin to blank areas on a map, which could be filled in by more research. Unfortunately, in many cases uncertainty does not behave like this. In the case of earth systems, we may find that scientific attempts to discover more about a phenomenon actually generate more uncertainty by revealing that elements we have little knowledge of are actually more complex than imagined and thereby increase the range of possible outcomes for the system even further (Painter, 2013: 6).

Spiegelhalter (2012; see Appendix, p. 35) suggests using the idea of ‘possible futures’, which has proved useful in the area of hurricane warnings. When scientists need to convey that there is a range of things that might happen, showing the various possible routes of a hurricane assists the public in appreciating the different possible behaviours of the weather system. Spiegelhalter is joined by Sandman (1988) in encouraging scientists to proclaim and emphasise uncertainty so that listeners are not expected to decode its significance themselves.

Scientists can also make clear the areas and extent of their uncertainty and how their state of knowledge might change. Pidgeon (2012; see

Appendix, p. 37) suggests making clear how scientists intend to address any identified uncertainty (by determining its extent, mitigating it, or developing flexible/reversible policies, which can change with new evidence or with widening stakeholder involvement).

Riesch and Spiegelhalter (2011), Spiegelhalter (2012a; see Appendix), and McCapra (2005) place the responsibility for good communication of technical terms and figures on the scientist, who must guard against misapprehension by writing accessible press releases to explain their findings. They argue that scientists must compensate for the fact that the public may have flawed understandings of scientific terminology and activity; scientific input is needed in public discussion, so scientists need to find ways to convey their positions meaningfully; and scientists must be aware of the misconceptions others may have about their research and work to explain these.

The Deficit Model

Aside from the need to think about the dissonance between scientific and public discourse, research also suggests that scientists need to reflect on their tacit assumptions about what is, or should be, happening when they engage with the media. According to Smith (2005), many scientists hold a model of science communication which views the flow of knowledge as a linear transmission from scientists, through journalists, to the public:

The climate change science and policy community participants at the seminars have consistently charged the media with having failed in what they view to be a duty to inform. They suggest the media are responsible for public ignorance of both causes and consequence of climate change. (Smith, 2005: 1473)

This model has variously been termed a 'hypodermic', 'transmission', or 'information deficit' model of scientific communication and it conceptualises the public as passive recipients of knowledge, which is held by the scientists and can be either faithfully or falsely transmitted by good or bad journalists. 'They feel that the news media simply need to recognize their responsibilities as a mediating channel on the subject of climate change' (Smith, 2005: 1473).

In science communications theory, this model is considered archaic and simplistic. Ropeik (2012: 1224) talks of it as 'the common approach to risk communication, which is often simply telling people only what the experts think they need to know, to try and make them think and do what the communicators have decided people ought to think and do'. As the discussion above demonstrates, there are many ways in which it proves inadequate. For example, the media have an entirely different set of criteria to meet when engaging with scientists (Sandman, 1988); other actors (NGOs, IGOs, businesses, etc.) have their own agendas to pursue in presenting information to the media (Kitzinger, 1999); the public will engage with media articles according to their own preconceptions (CRED, 2009); and they may develop entirely unforeseen responses to risk (Kasperson et al., 1988).

This does not mean that scientists should not continue to aim for accurate and informative media coverage in their area of expertise, but it does mean that they must be aware of the social context in which they speak and the role that they are playing. As Peter Stott points out (2012' see Appendix, p. 43), climate science should be 'policy relevant, without being

policy prescriptive'. Science communication is not about the linear communication of facts from the expert to the lay person, but about facilitating scientifically informed debate about the different policy options available. As Pielke's (2007) book *The Honest Broker* argues, scientists should be a resource for public debate. An assumption that journalists should be communicating what scientists consider important, without taking time to understand what journalists consider important or reflecting on how that knowledge informs policy, will lead to frustration.

On the other hand, there are good reasons why scientists feel the need to uphold the deficit model. Particularly in the case of climate change, one of the most profound challenges for scientists is that their own pronouncements may be presented misleadingly or in ways that contribute to political agendas at variance with those of the scientists. This is a phenomenon most often tackled by researchers looking specifically at climate change (Hulme, 2009; Pielke, 2007; Moser and Dilling, 2004), where sceptics of different persuasions jump on uncertainties to sow doubt and prevent government intervention or action (Painter, 2013: 22ff.). Oreskes and Conway (2010) argue that this tactic was also used by those promoting inaction on ozone depletion, acid rain, and health risks like smoking.

Normal scientific uncertainty (in the statistical sense and in the sense that uncertainty always characterises the frontiers of science) can often be used by those who want to cast doubt upon scientific knowledge and suggest that scientists know too little to make any meaningful pronouncements about risk. It can be used to create the impression of ignorance and promote inaction when the scientific community are largely in agreement about the extent of the problem and believe that it is important to address it.

This can leave scientists believing that reviving the vestiges of the deficit model is the safest way to protect the epistemic privilege of the scientific pronouncement and guarantee respect for the expert. Theoretical work by, for example, Latour (2004), Ashe (2011), Demeritt (2001), and Pielke (2007) offer arguments for rejecting the deficit model as itself implicated in making scientific discourse vulnerable to the kind of misrepresentation that takes advantage of public misperceptions as to what science is and how it operates. An awareness of this propensity amongst scientists to revive the deficit model can help them to understand and overcome their own frustrations when engaging in science communication.

4. Challenges for the Media

The typical news story on environmental risk touches on risk itself, while it dwells on more newsworthy matters. (Sandman, 1988: 37)

As discussed above, scientific pronouncements on risk and uncertainty are not always easy to understand or convey. The literature suggests that the main challenge for journalists in reporting on risk and uncertainty is reconciling the desire to produce scientifically accurate and informative stories with the many journalistic conventions that govern the creation of 'newsworthy' material. First, this necessitates a certain level of mathematical and scientific literacy and, secondly, it requires negotiation of journalistic norms, which encompass a wide variety of drivers, including the desire to entertain and attract readers or viewers (rather than just inform). This can encourage the exaggeration of health or environmental risks to make the story more dramatic, to link them to particular disasters, or to emphasise contestation around an area of science that most scientists agree on in order to give the story some dramatic tension. In this final section we focus on four elements of journalistic craft – accuracy, balance, proportionality, and detachment – that impinge on the way the media report risk and uncertainty and offer challenges for better reporting in the future.

Accuracy

Previous discussion has made it clear that danger is not objective. 'No single metric can adequately describe the diversity of key vulnerabilities, nor determine their ranking' (Hulme, 2009: 194). Nevertheless, it is still important that reporting of scientific stories are faithful to the science that led to them, because it is only with accurate information that the public can make the value judgements that, in a democratic society, determine which risks we choose to heed and which we neglect.

LaFountain (2004) offers nine necessary pieces of information that he thinks should be included in a news story if the public are to obtain an accurate understanding of risk:

1. the upper and lower bounds of the health risk and its average value must be included;
2. the magnitude of the baseline risks must be explained;
3. caveats within the academic study being used as a source must be made clear;
4. the findings must be compared with other risks, so the reader/viewer can grasp the relative risk;
5. it must be clear what qualifications any expert voices used in the article have;
6. it must be explained how objective the sources may be supposed to be;
7. it must be clear how new knowledge relates to the overall body of knowledge on the topic;
8. it must be stated whether the study is peer-reviewed, and;
9. coverage should avoid real-life examples, unless they are appropriate for conveying statistical significance.

LaFountain's analysis of three different issues (fear of electromagnetic fields, the effect of chemicals on breastcancer rates, and of chlorine on human health) finds that, '[w]hile the nine points previously suggested may be included in *good* risk reporting, they are not addressed in *most* risk reporting' (LaFountain, 2004: 50).

There are many ways that journalistic reporting can offer misleading information about risk. Some are products of journalistic practice, as when editors write headlines without fully reading the articles in question, something which can greatly anger readers (Shuckburgh, 2012; see Appendix, p. 38). Others are due to scientific illiteracy of largely non-specialist reporters who have been asked to cover scientific news stories.

In their examination of media coverage of the North West Public Health Observatory's (NWPHO) report on *Local Alcohol Profiles for England*, Riesch and Spiegelhalter (2011) show that a press release packaging the findings as a series of local alcohol profiles led to journalists running stories about how more affluent areas show higher levels of hazardous drinking. Actually, the tables did *not* find that affluent areas were subject to more hazardous drinking, because they were created using estimates of drinking levels: 'since the league tables are synthetic estimates, based largely on the class composition of the different local authorities, the hazardous drinking league table is essentially a league table telling us which local authorities are most middle class' (Riesch and Spiegelhalter, 2011: 51).

Riesch and Spiegelhalter also looked at the World Cancer Research Fund (WCRF)'s study of the effects of nutrition on cancer. Here newspapers reported that processed meat, like bacon, could cause cancer. While the original report 'provides an estimate of a 20% increased risk of bowel cancer for each additional 50g per day of processed meat (equivalent to a large bacon sandwich)', it did not make clear what the baseline risk was. The 20% increase actually meant that if 1,000 people *did not* eat processed meat every day, then four of them would be likely to develop bowel cancer, and that if 1,000 people *did* eat processed meat in the quantities mentioned, then that number would rise to five. Five is a 20% increase from four, but it is only a relative risk. When we know the absolute risk is an increase from 4 in 1,000 to 5 in 1,000, the figures seem far less frightening. There was such confusion around this statistical point that Hawkes (2007) wrote a newspaper article in *The Times* to try and explain it to readers. Spiegelhalter (2012a) recommended communicating this most clearly pictorially, by showing an image of a thousand figures, with four coloured in, and then with five coloured in, as a simple way for lay people to appreciate the difference.

For those to whom statistical inference does not come easily, understanding information about risk is very difficult. When the journalist conveying the information has little understanding of it either, the confusion increases. Aside from suggestions of more specialist science reporters, more scientific education for reporters, and better techniques for reporting statistical information, such as giving natural frequency (one in ten rather than 0.1), many researchers do feel that this is something scientists must take responsibility for. From the discussion in the literature, we may infer that press releases should be couched in ways that appeal to journalists, but they should be accurate. They should contain the important statistical information, but they should be written in user-friendly ways, which will allow journalists to convey information to the public with as little misunderstanding as

possible. Journalistic responsibilities need to be complemented by scientists' efforts to present complex information as simply as possible and journalists should not be afraid to ask for information to be presented in more accessible formats.

Examples of good practice in communicating risk to the public in simple, user-friendly ways include the work of the National Institute of Health and Clinical Excellence (NICE), the job of which is to offer patients considering treatment on the NHS a clear account of existing research on that treatment and the risks involved. Wendy Jarrett, Associate Director of Media Relations at NICE, lists some of the ways this is done (see Appendix, p. 39).

However, Jarrett notes that NICE's media engagement was not always exemplary and that the 'NHS Says it's Too Expensive to Keep you Alive' (Daley, 2009) type of coverage of NICE decision-making had become a common frame for the UK media. Jarrett explains that internal bureaucracy had to be overhauled to address the mistake of not providing press releases at key moments, and to better explain NICE's criteria for recommending a treatment be used on the NHS. If a drug is not found to be cost effective it is not purchased – this does not mean that it is too expensive, but that more effective drugs can be purchased more cheaply. This greatly reduced coverage of NICE decision-making because 'NHS prescribes cheaper and more effective drug' is not newsworthy.

Balance

One convention in journalistic reporting that often comes under criticism within the literature is the notion of 'balance'. Boykoff and Boykoff's (2004) 'Balance as Bias' looks at global warming in US newspapers and argues that the desire to provide 'both sides of the story' led to the false impression that scientists are divided about whether climate change is actually happening. Boykoff's later work showed that the problem had diminished in the broadsheet media in the UK and the USA, although some commentators still view 'false balance' as a major problem (Jones et al., 2011, on the BBC). Tammy Boyce's work on media coverage of the allegations that the MMR vaccine could cause autism in children also finds that the media struggled with its 'formal commitment to balance' (Fitzpatrick, 2008).

In some ways, this is a problem of incommensurate scientific and journalistic cultures. As Sandman (1988: 37) puts it, 'For science, objectivity is tentativeness and adherence to evidence in the search for truth. For journalism, objectivity is balance'. When faced with two contradictory accounts of an issue, journalists fulfil their obligations to objectivity by covering both. Scientists often feel that they should be more aware of the qualifications of those propounding the two accounts, but Smith points out that it is difficult in specialist areas like environment and health for journalists to attain the level of expertise that would allow them to discern how reliable a source is.

Journalistic decision makers can look at the spread of seats for different political parties, or the size of a business sector or union membership to gauge whether their coverage is 'balanced' and 'appropriate,' but rarely have the levels of scientific literacy required to make similar judgments about stories founded in scientific discourses. (Smith, 2005: 1474)

Again, the need for better scientific education amongst journalists and greater specialisation is implicated.

Smith also notes reluctance on the part of journalists to engage with social scientists, even on risk stories which would benefit from this perspective. News editors ranged from saying they were 'not plugged in' to social science to admitting that they did not respect social science as a branch of knowledge (Smith, 2005: 1475). Greater familiarity with scientific and social scientific communities may help to alleviate some of the problems of false balance, by giving journalists the tools for evaluating whether the narrative tension gained from presenting two accounts is legitimate, or whether it provides a false perspective on overall disagreement within the scientific community.

Proportionality

Proportionality can raise a number of problems for journalists. Harrabin et al. (2003) point out that the frequency of health-related news stories does not reflect proven health risks, with certain kinds of health risks (Measles, vCJD, Aids) achieving far more news coverage per case than bigger killers like smoking, alcohol, obesity, and mental disorder.

In many ways this reflects the idea of newsworthiness, because rare events are actually more interesting to journalists than common risks. Spiegelhalter (2012a; see Appendix, p. 35) points out that because it is their job to cover rare and exceptional events, journalists often neglect to make clear how rare these events actually are. Journalistic narratives can thus be accused of 'denominator neglect', because they focus on the few times when someone at risk actually suffers (numerator), rather than the many times when those at risk go on unscathed (denominator). Blastland and Spiegelhalter (2013) offer an example of this, by contrasting stories about affective reactions to an abandoned bag on the Tube (influenced by haunting stories of terrorist attacks) with the statistical information that 30,000 bags were left on the Tube in 2011. One may infer that the chances of an abandoned bag containing an explosive device are therefore something like one in 30,000, but, because we are so familiar with the story of the exception, abandoned bags tend to incite fear, despite a miniscule risk.

It is also clear that, of the four examples of health issues listed above by Harrabin et al. that do not gain much coverage, three are personal choices over which the individual has some control, reflecting the findings of risk psychologists that people fear involuntary risks more than voluntary ones.

As Ropeik points out, proportionality is not something that comes easily in media reporting because human beings simply do not assess risk in a rational way. We respond to risk in an affective way and so respond to narratives that appeal to that affective appreciation of risk. Most people do not choose to sit down and read dry statistical data about the relative risks of every aspect of our lifestyles. Nevertheless, awareness of this propensity could help journalists communicate more accurately by making clear how newsworthy risks compare to everyday risks.

Detachment

Another challenge for journalists is greater self-awareness of their role in politically sensitive issues. Smith (2005: 1478) has noted a myth of detachment amongst editors, which made them uncomfortable with risk stories that

seemed to dictate particular policy actions or lifestyle choices. '[Y]ou've got to understand this – we're not here to tell the public how to behave – we're there to tell them what's happening' (Smith, 2005: 1479). Journalists do not see it as their role to dictate healthy behaviours to the public or tell them which risks they should be most afraid of.

The idea of detachment is an important one for journalists. Johnstone *et al.* (1972: 522) note that:

the principal direction of American journalism during the first half of the twentieth century was toward establishing itself as a profession, and it was this era which saw the proliferation of professional schools, the articulation of codes of professional ethics, and the maturation of the ideology of 'objective' reporting.

Although challenged by views of journalists as advocates and watchdogs, this commitment to an identity as a detached observer, faithfully reporting back a naturally apprehended 'truth', is deeply rooted.

In conflict situations or disasters, the need to stay detached and neutral is considered the essence of what makes journalistic coverage powerful. Graeme Robertson, a photojournalist in Iraq, argues that his power lay in the ability to take photographs and that 'By meddling in situations of which he had imperfect knowledge, he risked becoming "more or a hindrance than a help"' (Knight, 2012).

In short, there seems to be a certain amount of unwillingness to engage with these challenges too deeply, for fear of entering difficult territory. Yet Smith points out that there *are* moral or policy questions on which newspapers are willing to take a stance. Indeed Burgess (2009) makes clear that they often undertake campaigns to highlight particular risks and demand that something be done. When faced with a complicated political or environmental issue, many reporters reassert the value of neutrality to justify the choices they make about coverage, but they may need to consider the argument that, in cases of major environmental risk or health statistics, accurately communicating that risk may inherently imply particular actions and appear to be dictating behaviours.

5. Conclusion

This literature review has given a comprehensive look at the media's reporting of risk and uncertainty. It began by making clear that the terms in question are not as strictly defined as one might expect. Even amongst different branches of science and different professional risk management roles, the terms can be used in different ways. The media, therefore, are faced with the task of communicating highly technical information, which is conceptualised slightly differently by different experts. In addition, although risk and uncertainty are often thought of as hard statistical concepts, there is an abundance of evidence from the literature that emphasises the human side of risk and the cultural negotiation and understandings of risk. Indeed this dual appreciation of risk, statistical and affective, is a key to understanding its great significance and fascination for society.

The media plays a fundamental role in communicating scientific knowledge about socially important issues and helps to shape social understandings and rankings of risk. Mairal (2011) argues that risk has always straddled that gap between official disaster statistics (insurers, governments, scientists, etc.) and public disaster narratives, from its emergence as a concept linked to insuring against maritime disasters. A key question for those considering the media reporting of risk and uncertainty is often, therefore, whether the media coverage of risk, with its story-telling, affective impact, is accurate by the standards of the professionals compiling risk statistics. An oft examined hypothesis is whether media sensationalism is responsible for making people more scared than they need to be, but various examples challenge this hypothesis, not least Ropeik (2012)'s point that in many cases media reporting leaves us *less* scared than the evidence warrants.

In section 2, we considered the literature exploring how, when and why media reporting of scientific risk and uncertainty occurs. We looked at the different theoretical approaches researchers use to understand how journalists frame risk and uncertainty stories, noting the flexibility of risk narratives: there is no neutral way to present this information; there are a number of narratives new information can be situated within; and readers/viewers will nevertheless bring their own interpretations to the material and co-create new understandings when engaging with journalistic material. Considering when and why news stories were covered, we saw that journalistic tacit knowledge about what counts as 'newsworthy' is fundamental in deciding when a potential story is reported. Nevertheless, actors providing information to journalists play a major role in explaining why reporting takes the form it does.

In considering what the literature teaches us about scientist and journalist interaction, we started by noting that one of the challenges for scientists is the risks to themselves, their work, and their reputation if public engagement were to go wrong. They also face difficulties communicating with audiences that view 'science' as knowledge, rather than as a process and methodology for investigation. There was a tendency for scientists to retain a 'deficit model' of science communication, which expected journalists to accurately disseminate expert scientific knowledge to passive members of the public. They placed the impetus on the journalist's 'duty to inform' (Smith, 2005) and lamented journalists' failure to recognise this. However, a better model for scientists to use is suggested by Pielke's 'Honest Broker', offering

policy-relevant expertise, rather than streams of doubtless accurate, but indigestible information to journalists and the public. An appreciation of the journalistic concern for newsworthy information would be an important awareness to foster amongst scientists.

With regards to journalistic challenges, the literature made clear that the major concern is statistical accuracy. While journalists naturally communicate the affective side of risk and uncertainty, the narrative values of risk are often evident in their conceptions of 'newsworthiness'. So it is more difficult for them to ensure that the drama of a risk or uncertainty story is also statistically appropriate. 'Denominator neglect' means that the rarest event is of most narrative value, but it is seldom made clear exactly how rare such events are, leaving the public more aware (and therefore afraid) of the infinitesimal risks than of the major ones.

When reporting on difficult statistical information about risk and uncertainty, the required level of mathematical and scientific literacy was found to be absent amongst the majority of journalists. The literature likewise suggested that many journalists' lack of familiarity with scientific communities makes it difficult for them to be sure they are offering balanced reporting of an issue and not highlighting scientifically marginal views in order to fulfil a need for dramatic tension or balance in their story-telling. A further problem was a tendency to withdraw from the complexities and criticisms involved in the reporting of risk and uncertainty by pleading the need for journalistic detachment, arguing that journalistic responsibilities do not stretch so far as ensuring the public know which lifestyle choices are most damaging to their health or why scientists believe environmental policy is necessary or not in a particular area.

Overall, the literature makes clear that risk is at once a statistical and a human concept. Scientists tend to emphasise the statistical and journalists the human, but good reporting and good engagement will be aware of both. Sometimes journalistic reporting of risk is just plain wrong and misleading, but equally scientific communication can sometimes entirely misunderstand what journalists and the public need from scientists if their expertise is going to facilitate understanding and informed debate rather than create confusion.

Ropeik argues that we must 'promote awareness of what research has learned about the affective way people perceive and respond to risk'. So that scientists and risk assessors particularly 'realize that there is no knowable single truth about any risk with which we will all agree . . . will help get beyond the stubborn, and ultimately dangerous, belief in the Holy Grail of perfectly fact-based reason and rationality'. This allows science communicators to create trust and influence through 'taking into account how people feel, and *why* – seeing the issue through the eyes of the audience – is vital to establishing true dialogue' (Ropeik, 2012: 1224).

Ropeik advocates mental modelling as a rich approach to science communication, but urges communicators to recognise that:

even with perfect communication and complete information, some peoples' feelings still would not align with the scientific evidence, and their perceptions may well give rise to risks of their own, and that the discrete risks of The Perception Gap risks must be recognized and addressed just as any other risk would be. Once that is accepted, those additional risks can be studied and

managed in the same way we already deal with any health care challenge.
(Ropeik, 2012: 1225)

Ropeik offers an example of this approach in the field of vaccination choices. He notes that, however much scientific evidence demonstrates vaccination to be safe, public perception will not always align with this and there will be a number of people who do not have their children vaccinated. This in turn leads to the spread of vaccinatable diseases. Ropeik advocates calculating the morbidity and mortality attributable to this perception gap and factoring this into decision-making so that policy-makers can 'create conditions that will encourage – but not mandate – certain choices' (Ropeik, 2012: 1225). While the benefits of this approach to risk are far clearer in the area of health risks, a deeper appreciation of the dual faces of risk and the way lay people apprehend it would also help science communicators in more complicated and polarised areas such as environmental politics.

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Appendix: Conference on Communicating Risk and Uncertainty 15 November 2012, St Anne's College, Oxford University

Opening Address: 'The Challenges of Communicating Risk and Uncertainty'

Professor David Spiegelhalter, Winton Professor of the Public Understanding of Risk, Cambridge University

Professor Spiegelhalter began by distinguishing risk from uncertainty: risk is a quantitative concept of how likely a particular event happening is (or 'where rough numbers can be put on a reasonably understood problem'), while uncertainty is a qualitative concept and refers to a dispute about how much risk there is on a particular issue (or 'where there is important doubt/dispute about the numbers or how to structure the analysis'). He pointed out that these two concepts often get confused in public debate.

Professor Spiegelhalter then went on to note some trends in the media's reporting of risk and uncertainty. He first discussed the example of an alleged IQ-alcohol link in an article in the *Independent* that day.

He said that in general, the rarer things are, the more coverage they get when they happen. There were strong journalistic narratives around numerators, which led to 'denominator neglect', i.e. in the risk context, a focus on the few times when someone at risk actually suffers (the numerator), rather than the many times when those at risk go on unscathed (the denominator).

He gave various examples of poor coverage. For example, the *Express's* 6 June 2011 coverage of the increase of risk in cancer from eating bacon sandwiches could have been done better.

He also argued that the pressure to produce a good headline has led to unclear, and sometimes inaccurate, reporting of risk and uncertainty. However, he noted, there are various steps which could be taken to provide greater clarity.

First, some metaphors work better than others for communication purposes – illustrations of 'possible futures' can be more illuminating than other common diagrammatic devices in the reporting of risks like hurricane warnings, for example.

Secondly, reporting of the chance of a particular statement being wrong, rather than simply listing the chance of the event happening, can give a clearer idea of what is actually being said.

Thirdly, he cited Peter Sandman's advice on reporting risks, particularly the following three guidelines: (1) instead of just acknowledging uncertainty, proclaim it and state how much uncertainty there is; (2) note how uncertainty is changing; and (3) come across as human.

Fourthly, he talked of the need for good guideline practices, and noted approvingly the government's material on how they themselves communicate uncertainty, and the guidelines from the Science Media Centre.

He also drew attention to the evidence by David Willetts (Minister for Universities and Science) to Commons Science and Technology Select Committee on 1 December 2012, when he said:

- There are a range of uncertainties in science.
- There is a tension between scientists who give advice across a range, from a best case to a worst case scenario, and we know that it is very easy for the media then to pick up on the worst case and the political process to be driven absolutely by the worst case rather than the range of risks.
- Communicating the intrinsic uncertainties in scientific advice is something that we probably need to do better.

Professor Spiegelhalter stressed scientists' responsibilities in setting the tone of communication. He suggested that common clichés about risk and uncertainty – such as the belief that the media always demand certainty; that discussing risk may lead to panic; or that the reporting of uncertainty may lead to mistrust and derision – may not be true, although we often act as if they were. This, he noted, can be dangerous when it leads to premature reassurance, such as in the case of the L'Aquila earthquake.

He finished by summarising the work of Sandman, when he made recommendations on what to say when communicating risk:

- that the risk is uncertain
- what you think the probabilities are, and how much confidence you have in your opinion
- what evidence you have to support your view, and what additional evidence you wish you had but don't
- what other experts think, the extent to which they agree or disagree, and the basis for any disagreement
- what you are doing to reduce your uncertainty, and when you might have more information.

QUESTIONS

A number of audience members pressed for a wider apportioning of blame beyond the scientific community. One questioner pointed to the contradictory incentives in play in the media. Others pointed to a possible assimilation bias which everyone exhibits; it was suggested that, if the public are keen to misunderstand some reporting, then there is little that can be done. Professor Spiegelhalter, however, argued that journalists are badly served by the scientific community. He suggested that the scientific community should preempt misunderstandings when dealing with the media. He said poor reporting of risk in the media was primarily caused by the poor press releases issued by journals and university press offices.

Another audience member later added that it might be useful for scientists who are talking to journalists to imagine what editors might want to hear, and make it clear whether this is or is not the case. Others pointed to the importance of the wider legal framework and the use of naming and shaming through unofficial routes.

Another point which came up in the discussion was the use of language about risk and uncertainty. Professor Spiegelhalter was asked whether discussing 'certainty' rather than 'uncertainty' can be more useful. He agreed, and also suggested that terms like 'confidence' levels can also be helpful. He said scientists should not simply communicate through the media in the terms they use, when these may be confusing to the wider public.

Session 1: 'Public Understanding of Risk and Uncertainty'
Chair: Bob Ward (Grantham Institute, LSE)

Professor Nick Pidgeon, Cardiff University

Professor Pidgeon began with a discussion of risk-basic concepts. He noted that the concept of 'formal risk' does not admit of a single definition. On the one hand it can refer to the likelihood of harm, and on the other it can refer to the product of the likelihood of harm and the consequences. There are further definitions used on the regulatory level. Building on work by Andy Sterling, however, he outlined a way of understanding a number of interconnected concepts. These concepts can vary on two dimensions: knowledge about the outcome and knowledge about the likelihood. Risk and uncertainty are both concepts which admit of unproblematic knowledge of outcomes. The difference is that risk admits of unproblematic knowledge of the likelihood, while uncertainty admits of problematic knowledge on this dimension. There are two corresponding concepts when knowledge of outcomes is also problematic: ambiguity and ignorance. Uncertainty is obviously more difficult to act under than risk, but the number of potential responses to 'deep' uncertainty was noted: uncertainty assessments (i.e. determining how uncertain we are); placing a premium on flexibility and reversibility; and widening stakeholder participation.

Professor Pidgeon went on to discuss risk perceptions, pointing out how public understanding of risks often involve other factors (e.g. involuntariness, perceived benefits, cultural and political factors, trust in risk managers, social amplification) than are used in the scientific community (the literature has often compared the definitions used by the public to the definitions used by engineers when discussing nuclear power). Professor Pidgeon then noted some trends in public risk perception on climate change: varying levels of concern over time (although meta-beliefs have remained largely stable); tendency to think the science is contested; confusion with other environmental issues; perception of it as a distant problem; and a tendency to not always connect with anthropological causes. Demographics, particularly value positions, as well as media amplification, are important in determining views about climate change.

A possible risk to public health is likely to become a major media story to the extent it involves:

- questions of blame
- alleged secrets and cover-ups
- human interest
- links with high profile issues/ persons
- conflict
- signal value
- many people exposed
- strong visual impact
- links to sex or crime

Professor Pidgeon suggested that climate change risk communication strategy has recently moved from a focus on public understanding to an approach involving more stakeholder engagement.

Professor Pidgeon called for a reframing of communication of climate change. He wanted to focus more on the risks involved, rather than the uncertainties. The 'institutional response', which he has developed with Baruch Fischhoff, suggests that the strategic capacity for effectively communicating climate science and risk communication needs to be improved.

In the battle over climate interpretations, Pidgeon said that scientists struggle to communicate core certainties and residual uncertainty clearly, whereas sceptics seek to emphasise uncertainty. This, he said, implies a need to reframe climate change explicitly around risk and uncertainty – focusing on *decisions*.

Dr Emily Shuckburgh, BAS/DECC

Dr Shuckburgh outlined the results of a recent report she had jointly authored on 'Climate Science, the Public, and the News Media'. She began by noting how individuals understand risks in general, and attitudes to climate change in particular. Individuals are only good at judging risks they have experience of and often exhibit an optimism bias. What this means for attitudes towards climate change is that the public often relate to it through a generic model of pollution, or their own direct experience of weather. They also view it as something distant. Polls have shown a reduction in the amount of worry over climate change in the period 2005–11, as well as an increasing perception of the exaggeration of risks. This may be explained by individuals' finite pool of worry, as well as issue fatigue.

Individuals' responses to newspaper reports of climate science were outlined. There was a negative response to the perceived incongruity between headlines and the main body of the text, and even between different paragraphs of the main text itself. (She gave the example of an article in the *Daily Telegraph*, headlined 'Floods Caused by Climate Change'.)

Examples were also given of anger from members of focus groups when they saw several different opinions listed. Examples were shown from the *Daily Mail* and the *Sun*, when the experts were not sure, and the response from readers was anger. She reported that phrases like 'loading the dice' (often recommended as a communicative tool to describe the way that climate change influences the chance of extreme weather events) actually led people to infer that climate scientists were 'loading the dice' in terms of the underlying science, attempting to unduly influence the outcome of their research.

Words such as 'could,' 'may,' or 'suggest' were taken to imply complete ignorance. Meanwhile, phrases like 'very likely' were taken to imply a lower chance than is actually meant by the IPCC (70%, compared with 80–90%). Consider the statement from the IPCC 2007 reports that 'average Northern Hemisphere temperatures during the second half of the 20th century were very likely higher than during any other 50-year period in the last 500'. It is hard to believe that the authors had in mind probabilities lower than 70%, yet this is how 25% of our subjects interpreted the term 'very likely'.

Dr Shuckburgh also noted the importance of framing in responses: positively framed statements with greater uncertainty created a greater willingness to act on the part of respondents in one survey.

Dr Shuckburgh closed by suggesting that the way in which risk and uncertainty is presented should depend on the purpose of communication. Different motives, such as attracting attention, informing, or changing behaviour will be served best by different methods. The use of graphs, for example, will be useful for some purposes more than others. Finally, she listed suggestions from focus groups for communicating risk and uncertainty: not using jargon; making it relevant; and injecting passion. Tabloid articles were frequently praised for their clarity when compared to broadsheets.

QUESTIONS

The speakers were asked if they had any thoughts about how to better train young academics in communicating risk and uncertainty. Professor Pidgeon suggested workshops on this, as well as better interaction. It was suggested by another audience member that a major problem is that the public do not understand percentages very well, and they asked whether using metaphors would be more useful. Professor Pidgeon warned that language can be slippery and unclear at times as well. Dr Shuckburgh responded by going back to the last point of her discussion: the best way of communicating will depend on the intended purpose.

The speakers were also asked whether the stakeholder model had gone too far, and if the 'information deficit model' is still useful. Professor Pidgeon agreed that the deficit model is still of use. Dr Shuckburgh argued that the area of healthcare has made advances here, by utilising the notion of 'informed choice'. A further questioner asked whether we need to look at the foundation of people's views at a deeper level, and suggested that this does not sit easily on the communication-behaviour continuum. Professor Pidgeon argued that we must look at this matter from a decision perspective. Dr Shuckburgh said that the issue again comes back to who you are and what you want to achieve through communication.

Session 2: 'The Experience of Different Sectors in Communicating Risk and Uncertainty'

Chair: Roger Street, Green Templeton College, Oxford

Wendy Jarrett, Associate Director, Media Relations, National Institute for Health and Clinical Excellence (NICE)

NICE gives guidance on healthcare treatments, which unavoidably involve communicating risks. Wendy Jarrett began by outlining NICE guidance about how to communicate risk:

- Personalise risks and benefits as far as possible.
- Use absolute risk rather than relative risk (e.g. the risk of an event increases from 1 in 1,000 to 2 in 1,000, rather than the risk of the event doubles).
- Use natural frequency (e.g. 10 in 100) rather than a percentage (10%).

- Be consistent in the use of data (e.g. use the same denominator when comparing risk: 7 in 100 for one risk and 20 in 100 for another, rather than 1 in 14 and 1 in 5).
- Present a risk over a defined period of time (months or years) if appropriate (e.g. if 100 people are treated for one year, 10 will experience a given side effect).
- Include both positive and negative framing (e.g. treatment will be successful for 97 out of 100 patients and unsuccessful for 3 out of 100 patients).
- Be aware that different people interpret terms such as rare, unusual, and common in different ways, and use numerical data if available.
- Think about using a mixture of numerical and pictorial formats (e.g. numerical rates and pictograms).

Communicating uncertainty is also important in healthcare, both because patients have a right to know where there is uncertainty, and also to suggest where further research can be fruitful. At the end of all NICE guidance there are research recommendations. Knowing about uncertainties is important regarding new medicines as well, since for a new medicine to get a licence in the UK, it must be shown to be safe and effective (meaning more effective than a placebo). For medicine to receive a NICE recommendation, the opportunity cost must also be taken into account, and knowledge of uncertainty is important for this as well.

NICE has received negative coverage in the media in the past due to their previous policy of not releasing press releases when preliminary reports come out. An effort was made to improve this policy, and release more press releases. This receives less coverage in national news, and more informed coverage in the specialised press.

Elliot Varnell, Consulting Actuary, Milliman

Elliot Varnell discussed the communication of risk and uncertainty by insurance companies. When insurance companies communicate to the public (through adverts) they do not talk about risks in great detail. Occasionally, events which are to be insured against are shown, but probabilities are rarely mentioned, and the cost-effectiveness is not addressed. Humour is a tool often used. Recently, there has been a requirement that with-profit insurance firms provide policy-holders a document of Principles and Practices of Financial Management (PPFM), which sets out how they make decisions around risks.

Communicating risk internally follows a different strategy. Here, statistical models are used to determine the risk to capital investment. Amid growing pressure on those within the company to understand the complexity of the risk they are dealing with, new techniques have been used. Most notable is the technique of 'cognitive mapping', where it is outlined how various parts of the business are linked. Key 'nodes' are singled out for special attention when they have a high number of links to other parts, and therefore can manifest themselves as large risks. Cognitive maps have also been used to determine conditional probabilities. Acknowledgement that there might be a risk culture issue in financial service companies is also starting to emerge.

Finally, communication with the market is essential to create confidence and therefore ensure continued capital investment. Insurance

companies provide risk reports which largely focus on capital. Recently, 'risk appetite statements' have been demanded by regulators to effectively communicate risk to the market. In addition, Solvency II is a recent EU directive which attempts to embed risk strategy at the heart of how financial services companies work.

Roger Street, Green Templeton College

Roger Street outlined key points from a series of recent lectures which took place at Green Templeton College, Oxford, which brought together four speakers with different perspectives on risk. They were: Dr Jim Watson (talking about the energy policy sector); Professor Nick Pidgeon (environmental social science); Dr Angela Coulter (medicine); and Professor Chris Rapley (climate science).

Roger Street drew together some common emerging themes from the four perspectives, which warrant further investigation. These were: (1) the relationship between the complexity of the system and the uncertainty of the decision-relevant information; (2) scientific integrity and the scientist's role as an advocate of change; (3) learning lessons from institutions and programmes practising multi-disciplinary research on the science-policy boundary; (4) measures to assess decision quality; (5) testing messages on trial audiences; and (6) risk-based and resilience approaches.

QUESTIONS

Wendy Jarrett was asked more about why there was such resistance in NICE to press releases in the past. She responded that there was the impression that there was no need for a press release for first drafts of decisions. Because this is not final guidance, it was not thought necessary, but the media would still write stories before the final guidance was out. She was also asked about the use of visual aids, such as graphs, in communicating risks to the public, and perhaps whether this depended on what the aim of communication was. She pointed to the practice of producing both short and long guidelines, with the latter including all relevant evidence.

Elliot Varnell was asked about whether there were any lessons from the insurance industry for communicating climate science, where 'tail risks' (i.e. low probability, high impact events) need to be addressed. He responded that, particularly outside the UK, the consequences of tail risks are shown in adverts, but probabilities are not mentioned. He also said that tail risks are important to discuss with the board. The board, working on a relatively low time horizon, may find it hard to visualise these events happening. Solvency II, however, has started to require managing with these risks in mind.

Session 3: 'Communicating Risk and Uncertainty in Climate Science'
Chair: Richard Black (Former BBC environment correspondent)

Professor Chris Rapley, UCL

Professor Rapley argued that in communicating science, first you need to know your audience. Working with teachers in schools has shown that non-scientists are taught to perceive science as a body of facts/knowledge, while researchers are interested in the frontiers of uncertainty. Expectations are therefore different. To a scientist a number is seen as useless without a probability range and a unit, making clear that there is a difference between

accuracy and precision. Scientists also want information about how the figures were arrived at, and have formal ways of communicating this. These habits are alien to the public.

The treatment of uncertainty by the IPCC 2007 report (known as AR-4) was confusing. The Working Group 1 (WG-1)'s table for equating numerical and linguistic conveyors of uncertainty has several faults. As the psychologist Daniel Kahneman has pointed out, human beings often misappraise risks. For example, 'Death by lightning was judged less likely than death from botulism even though it is 52 times more frequent'. The IPCC handling of probability is too complicated; confusing (because the intervals overlap); links numbers to words despite notorious problems with this; and ignores affect (how people feel about what they are reading). Budescu et al. found that the 'judgment literature indicates that there are large differences in the way people understand such phrases, and that their use may lead to confusion and errors in communication'. Words convey a greater range than they're intended to. There are many issues with how people read risk. Negative risks are experienced as over a greater range. Negatives exhibit a greater range and bias. Double negatives lose audiences. Uncertainty around consequences is of greater interest, etc. We have to be very careful about frames as 'X is *not very likely*' can be read differently from 'X is *very unlikely*'.

Oreskes and Conway's book *Merchants of Doubt* gives a good account of how normal uncertainty can be turned into public doubt. In 2010 The Royal Society recognised a move from the unknown, to the 'aspects that are not well understood', to a 'wide consensus but continuing debate and discussion', to 'wide agreement'. This is normal science, but uncertainty can be presented as a reason not to act. In big organisations we're used to a risk-based approach, carrying out risk appraisals for everything (risk is impact times probability of event), but if you are not part of that culture then you're not so familiar with this idea. In practice, if you encounter a foreign language sign that suggests an unexploded minefield, you don't think that uncertainty about it means you ignore the risk.

We must be careful how we communicate. There are perils involved in simplification. We want to give the public one clear and simple message so we offer things like the hockey stick graph, which is problematic because it is not really temperature records that matter, but the energy budget.

Peter Stott, Met Office

A brief outline of what the Met Office does was given, and can be found at <http://www.metoffice.gov.uk/about-us>. As scientists we want to be true to the science we're doing. In Stott, Stone, and Allen (2004) we said,

It is an ill posed question whether the 2003 heatwave was caused, in a simple deterministic sense, by a modification of the external influences on climate . . . However, it is possible to estimate by how much human activities may have increased the risk . . . (Stott et al., 2004: 610)

The paper had a media and policy impact as it was important with regard to future flooding. We need to quantify uncertainty, but it's much easier to quantify the lower boundary and harder to give a robust upper boundary limit.

The IPCC's attempts to calibrate language for speaking about uncertainty is useful as it aims to make different groups and disciplines consistent. We want to frame information so that it is clear what the likelihood is of the statement being incorrect. We need to make clear what is known and what is uncertain.

The Met Office is funded to do policy relevant, but not policy prescriptive research so we have a process for knowledge integration and a team to deal with it. In dealing with the media, scientists need the space to give the areas they are strongly confident of AND the areas where there is complexity. At a briefing with the Science Media Centre in 2010 (after the emails from the UEA were made public), an exchange with the BBC's David Shuckman discussing anthropogenic and solar-related climate change demonstrated that soundbites and ambushes are problematic, but a real conversation between scientist and journalist can be very productive.

So, in conclusion, we need to be true to the science and its complexity, be policy-relevant, but not policy-prescriptive; relate risks now with risks in the future; give good accounts of the knowledge we are confident of (even if this is a very simple climate 101), and then explain the new stuff. We must ensure we have the space to do this.

Professor Rob Wilby, Loughborough University

Climate change is important to infrastructure such as power stations, and our work is on water management. We try to fill in the gaps in the climate pyramid of uncertainty (see Wilby and Dessai, 2010). By populating the pyramid we generate increasing uncertainty. Example: if we want to know how the olive crop will change in Tunisia we model it and see that flowering gets earlier, but we have uncertainty ranges for each estimate.

We need a decision framework around people's vulnerability to uncertainty. The World Bank engagement in projects has recently suggested a sea change as adaptation has been put firmly on the agenda. Our job used to be to disseminate the information we gathered by making a model, but this is now developing into more of a conversation. This way we find out what information is needed.

We have tended to give big ranges of uncertainty, which have left people pursuing 'low regret' policies, which have benefits across the range. Currently we're working on an atlas of climate hazards (floods/droughts/etc.) in Yemen, which may seem trivial, but is very important in such a data-sparse field. We can't just disseminate this, we have to continually support how the data is interpreted.

It becomes very difficult when we have to make decisions about how money will be distributed. It is assumed that we can estimate risks in particular areas so we know where to invest in adaptation. So we need to be more pragmatic, give 'sensitivity tests and options appraisal', for example, how effective would de-silting in Calcutta's drainage be or what are the benefits under a range of scenarios. This gives a better narrative. The precautionary principle is useful here. If you can't be confident of sea-level rise then build in a big safety margin.

The Independent Evaluation Group (2012) World Bank Recommendations are to develop reference guidelines for incorporating climate risk management. They include:

1. Develop reference *guidelines* for incorporating climate risk management into project and program design, appraisal, and implementation.
2. Develop and *pilot* territorial and national-level measures of resilience outcomes and impacts for inclusion in an improved results framework.
3. Better assess the *costs, benefits, sustainability, and impact* of activities with presumed resilience benefits.
4. Support countries to improve *hydromet services* and encourage the use and sharing of hydromet information within and between countries.
5. Promote attention to *anticipatory adaptation* to long-run climate change.

QUESTIONS

The first questions revolved around a perceived misalignment of interests, with a questioner pointing out that it seems that a press release from scientists often has a blue-sky interest in the next funding project grant. The public want no ifs or maybes and journalists don't want a dull deepening of consensus. So there is a real misalignment of interests around the next IPCC report (known as AR-5). Professor Rapley agreed. The media want to know what the new story is. The only thing we can do is recognise it and make it clear in our press release. Peter Stott said we should distinguish between the best communication of the science, which we can improve, and telling people what to do so that decision-makers understand. He said we have to be consistent with the science, and that the IPCC AR-5 2010 guidelines give consistency across working groups. Professor Wilby said that lack of information can become a lack of political options, because we can't do much, but take a 'low regrets' policy. Professor Rapley said that we are in a stage of post-normal science:

when I talk about Higgs-Boson my audience may be interested, but it won't make a difference to their everyday lives. In climate change, scientists become suspicious because we have to engage with people's reactions to the information we give them. Medicine does this dialogue very well, engaging with people about what the options are.

Another set of questions focused on the issue of adaptation. In public discourse most are happy with adaptation, but it is the need for mitigation that is controversial. People argue we shouldn't reduce emissions until we are more certain. That framing of the debate is something scientists feel is wrong, but they don't see it as their job to reframe the debate. Professor Rapley responded that adaptation seems to crowd out mitigation, which is bad, but recent work on mitigation by PriceWaterhouseCooper meant projecting into the future and finding the outcomes so disturbing that they went back to looking at mitigation in order to prevent those futures.

A final question looked at the issue of communication where a questioner pointed out that good communication is two-way so therefore we need better feedback to climate scientists. Professor Wilby responded that there is no silver bullet. It helps when a project is ongoing, like his with the World Bank, which has run over five years. It is about being symbiotic and having input from new communities. Perhaps secondments between different

groups would help, as well as engagement over longer time periods. We need incentives to take placements outside academia.

Session 4: 'The IPCC's Communication of Risk and Uncertainty'

Chair: Cecilie Mauritzen, director, CICERO

Professor Myles Allen, Oxford University

Professor Allen began by discussing the communication of uncertainty in the IPCC's fourth assessment report (AR-4). Following confusion from by the way evidence was presented in previous reports, the IPCC wanted to synthesise quality of evidence and agreement of evidence into a single non-probabilistic 'confidence' scale. Statements of probability were only to be used when there was high confidence. He added that probabilistic statements about uncertainty should have an implicit account of what it would mean for that statement to be falsifiable.

He went on to discuss the problems of implementation of this guidance. In particular, he pointed out that statements which do not have a likelihood qualifier are generally seen as unimportant, and will not be focused on. But, he pointed out, there are various statements which have clear policy implications, which are falsifiable and which we have high confidence in, which do not have such qualifiers. The IPCC guidance on uncertainty language is thus unduly restrictive.

There are various problems, Professor Allen argued, which uncertainty language cannot solve. IPCC statements aim to be 'impossible to misunderstand', but he pointed out that there is a risk that the statements which meet this criteria may be 'impossible to understand' or 'vacuous'. He thought, therefore, that the criteria were unnecessary, since communication, particularly about uncertainty, depends on the context it is made in. He suggested that the IPCC should give up on only using one single vehicle for communication of climate science (i.e. through assessment reports).

Professor Arthur Petersen, Chief Scientist of the PBL Netherlands Environmental Assessment Agency

Professor Petersen provided a view from the Dutch government delegation in the IPCC. He began by recalling an assessment which he was involved in of AR-4, in which a disproportionate focus on the risks was found. This was problematic for the following reasons: positive impacts are important as well; a question of how best- and worst-case scenarios are dealt with arises; there is a question of how models are used; and there is an issue as to whether only statements which a probability could be attached to should be included. He also mentioned the problem of expressing uncertainty language, such as 'very likely'. He stressed the role of expert judgement in coming to this conclusion involving this language. He also pointed out, agreeing with Professor Allen, that IPCC uncertainty guidance has led to reports which are difficult to understand.

He went on to discuss the IPCC's relationship with 'climate sceptics'. The climate sceptics have, in the past, accused the IPCC of not being open enough. However, Professor Petersen has found that the opposite is true; these voices have often been heard out. Nonetheless, he is still worried that the IPCC has not addressed sceptic arguments in great detail. In response to this, the Dutch government has financed a blog, *Climate Dialogue*, available

at www.climatedialogue.org, which asks scientists with different views on a number of topics to contribute to discussion about various issues about climate science.

QUESTIONS

Most of the questions were on the issue of whether the very general assessment reports of the IPCC still had a useful role to play in communicating climate science. Some audience members agreed with Professor Allen that this was a poor mechanism for communication, but others stressed the usefulness of giving policy-makers an overview of the current state of climate science, the effectiveness of having a single authoritative report for public engagement, and the usefulness of the process to developing countries, which often rely on the reports for information. Professor Allen argued that the aim of the IPCC of producing guidance which could not be misunderstood or misconstrued was fruitless. He advocated smaller, more focused reports on specific issues. He also said that less public engagement in these reports would not necessarily be a bad thing. Drumming up public interest is only useful if specific policies are being advocated, but this contravenes the IPCC's mandate.

Other questions focused on the use of blogs, such as 'Climate Dialogue'. It was asked whether there is a way to prevent the degeneration which often plagues internet blogs, and whether blogs have a bias towards 'contrarian' views. Professor Petersen suggested that a good policy would be to create more blogs. The 'Climate Dialogue' blog was set up with climate sceptics, so perhaps there is a bias there. It was also suggested that constructive engagement with 'contrarian' views should be more widespread, particularly in the IPCC. Professor Allen responded that, from his own experience, those with something useful to say are included in the IPCC process.

Panel Discussion: The Media's Reporting of Risk and Uncertainty

This session was a panel discussion with journalists Roger Harrabin (BBC environmental analyst), Fiona Harvey (Guardian environmental correspondent) and Kate Kelland (health and science correspondent, Thomson Reuters). The session was chaired by Tom Sheldon (Science Media Centre).

Tom Sheldon opened the discussion by posing some questions to the panelists based on what had come up during the course of the day. He asked, first, whether it is problematic from their perspective that a great deal of scientific output is unclear. Secondly, he asked how they deal with science that has uncertainties, and whether it is an oversimplification to say that journalists want certainty. Finally, he questioned whether scientists should be more forthright about their uncertainty.

Roger Harrabin began by highlighting various issues which affect the way in which the media reports health stories. He pointed to the effects of lobbying on this. He also argued that a number of factors present in a story put it on the agenda for news: (the appearance of) novelty, drama, conflict, and personality being especially salient. He pointed to previous research he

had carried out about the differing frequency of deaths per health story for different conditions on the BBC news.

Fiona Harvey was unambiguous about where she thought most biases and inaccuracies in science reporting came from: the lobby reporters at the House of Commons, fed political 'leaks' and 'spin' from Ministers and their Special Advisers. She also warned about the tendency of the search for exclusives and lack of specialists in this area of reporting.

Kate Kelland said that lack of certainty in science can often annoy journalists, who tend to want to have a clear point to lead on. However, she noted, the uncertainty can sometimes become that lead, even if this is might not be what editors want. She also talked about the Fukushima nuclear disaster, which she felt led to a learning process in newsrooms about reporting on risk.

The panel was asked about under what conditions a story can get more fragmented coverage. Coverage of the Chernobyl nuclear disaster was generally according to a fixed narrative, whereas there was more diverse coverage of Fukushima. Kate Kelland said that this was a positive development, and suggested the publishing of studies about the health risks of Chernobyl which were caused by fear itself might have led to subtler and more sophisticated reporting. Fiona Harvey remarked how Fukushima was a long-running story, and, as time goes on, journalists need to find new angles. Roger Harrabin pointed out how different BBC outlets will give different takes on a story.

The panel was also asked about the forthcoming IPCC fifth assessment report. They commentated about how it was difficult to respond immediately to such reports. Myles Allen, following his presentation earlier, questioned whether the reports were useful anymore. Roger Harrabin commented, however, that reporting on climate change had largely disappeared from the mainstream media, and that these reports provide a landmark event the media considers too big not to cover. Fiona Harvey added that the reports provide a justification for coverage of issues which have been ignored for some time. Kate Kelland agreed, and said that, like WHO reports, the IPCC assessment reports provide a reference point. Another audience member added the role of the IPCC in bringing the global scientific community together was important.

The panel were then asked whether different sorts of journalists treated risk differently. Science journalists may treat it differently from environmental journalists, for example. Fiona Harvey did not think that all journalists could be neatly categorised in this way. She pointed to a number of vested interests which all journalists face when writing a story, and suggested that there was often a bias to side with NGOs because of their perceived neutrality, but stressed that NGOs are special interest groups as well. Kate Kelland also pointed out that there are increasingly few science journalists. Roger Harrabin mentioned the BBC's Trust Report, which stated that proportionality, but not neutrality, had to be given to different points of view in science. He also said, however, that 'proportionality' was problematic. Alice Bell, who worked on the BBC Trust Review, later said that the real problem was perhaps the shortage of different voices being reported because of time constraints.

Another point which was raised in a number of questions concerned scientists communicating to journalists. They were asked about the push for certainty in science reporting. Roger Harrabin thought that the push for

certainty in the media could not be stopped. Kate Kelland also noted the role of editors in this pressing for certainty. She said that scientists should acknowledge uncertainty, but also say more about the uncertainty they encounter. Fiona Harvey also wanted more acknowledgement of uncertainty by scientists in order to avoid false accuracy. The panelists were asked whether journalists should acknowledge their own vested interests when speaking to scientists. Fiona Harvey responded that it was important that journalists' motives were kept separate from profit-making.

SELECTED RISJ PUBLICATIONS

Julian Petley (ed.)

Media and Public Shaming: Drawing the Boundaries of Disclosure (*published jointly with I.B. Tauris*)

James Painter

Poles Apart: The International Reporting of Climate Scepticism

Lara Fielden

Regulating for Trust in Journalism: Standards Regulation in the Age of Blended Media

David A. L. Levy and Robert G. Picard (eds)

Is there a Better Structure for News Providers? The Potential in Charitable and Trust Ownership

David A. L. Levy and Rasmus Kleis Nielsen (eds)

The Changing Business of Journalism and its Implications for Democracy

Tim Gardam and David A. L. Levy (eds)

The Price of Plurality: Choice, Diversity, and Broadcasting Institutions in the Digital Age

published in association with Ofcom

John Lloyd and Julia Hobsbawm

The Power of the Commentariat *published in association with Editorial Intelligence Ltd*

CHALLENGES

Naomi Sakr

Transformations in Egyptian Journalism (*published jointly with I.B. Tauris*)

James Painter

Climate Change in the Media: Reporting Risk and Uncertainty (*published jointly with I.B. Tauris*)

Suzanne Franks

Women and Journalism (*published jointly with I.B. Tauris*)

Nick Fraser

Why Documentaries Matter

Nicola Bruno and Rasmus Kleis Nielsen

Survival is Success: Journalistic Online Start-ups in Western Europe

Paolo Mancini

Between Commodification and Lifestyle Politics: Does Silvio Berlusconi Provide a New Model of Politics for the 21st Century?

John Lloyd

Scandal! News International and the Rights of Journalism

Stephen Coleman (ed.)

Leaders in the Living Room: The Prime Ministerial Debates of 2010. Evidence, Evaluation and Some Recommendations

Richard Sambrook

Are Foreign Correspondents Redundant? The Changing Face of International News

James Painter

Summoned by Science: Reporting Climate Change at Copenhagen and Beyond

John Kelly

Red Kayaks and Hidden Gold: The Rise, Challenges and Value of Citizen Journalism

Stephen Whittle and Glenda Cooper

Privacy, Probity, and Public Interest

Stephen Coleman, Scott Anthony, and David E Morrison

Public Trust in the News: A Constructivist Study of the Social Life of the News

Nik Gowing

'Skyful of Lies' and Black Swans: The New Tyranny of Shifting Information Power in Crises

Andrew Currah

What's Happening to Our News: An Investigation into the Likely Impact of the Digital Revolution on the Economics of News Publishing in the UK