Theory and language of climate change communication

Brigitte Nerlich,[1]* Nelya Koteyko[1] and Brian Brown[2]

Climate change communication has become a salient topic in science and society. It has grown to be something like a booming industry alongside more established 'communication enterprises', such as health communication, risk communication, and science communication. This article situates the theory of climate change communication within theoretical developments in the field of science communication. It discusses the importance and difficulties inherent in talking about climate change to different types of publics using various types of communication tools and strategies. It engages with the difficult issue of the relationship between climate change communication and behavior change, and it focuses, in particular, on the role of language (metaphors, words, strategies, frames, and narratives) in conveying climate change issues to stakeholders. In the process, it attempts to provide an overview of emerging theories of climate change communication, theories that recently have begun to proliferate quite dramatically. In some cases, we can, therefore only provide signposts to the most relevant research that is being carried out with regard to climate change communication without being able to engage with all its aspects. We end with an assessment of how communication could be improved in light of the theories and practices discussed in this article. © 2010 John Wiley & Sons, Ltd. *WIREs Clim Change* 2010 1 97–110

The Importance of Communicating About Climate Change to 'Publics'

The topic of climate change communication has of late become more salient in society and among social scientists and has resulted in 'the recent explosion of climate change communication from movies to grassroots movements'.[1] Analyses of climate change communication and its impact on the general public have been proliferating in communication and related discipline journals since the late 1990s. Despite this, carbon emissions continue to increase both globally and domestically, and society continues to be vulnerable to climate variability. This raises questions about the effectiveness of current communication efforts, and the ability of their audiences to implement change in response to these communications. Not only the persuasiveness of the messages, but also the

structure of society and considerations of the extent to which citizens are empowered to make effective change become important in this regard.

In this paper we will concentrate on recent analyses of communications about climate change and highlight some of their key findings. We will provide an overview of a selection of government, citizen, and science-led approaches to climate change communication, identify trends in media portrayals of climate change, and revisit the role of language in constructing messages about the topic. Because of the sheer volume of climate change communication studies, the scope of this review is limited, and does not include every peer-reviewed or popular press article on the subject. Nevertheless, this overview of applied and research case studies will provide a framework with which to probe the role of communication in perceptions of climate change, and examine the effectiveness of different tools in raising awareness and understanding of climate change. We will also briefly explore some of the barriers that may hinder effective climate change communication and subsequent motivation to act on these messages.

Over the last two decades much of climate change communication has dealt with issues

*Correspondence to: brigitte.nerlich@nottingham.ac.uk

[1]Institute for Science and Society, Law and Social Sciences Building, West Wing, University Park, University of Nottingham, NG7 2RD, UK

[2]Faculty of Health and Life Sciences, Hawthorn Building, The Gateway, De Montfort University, Leicester, LE1 9BH, UK

of uncertainty, most importantly, whether anthropogenic climate change was happening or not. Despite a lingering scepticism in the UK's popular press[2–4] a growing consensus can be detected among scientists and policymakers.[5] Most governments agree that climate change is now inevitable, anthropogenic in origin, and that, as reported in *New Scientist*, '[i]t's time to get practical over climate change'.[6] Communication efforts, therefore have changed from persuading people that climate change is happening to persuade people to adopt practical measures to deal with it.

However, climate change is still mostly invisible[7] and, confusingly, what is visible in the form of changes in weather patterns may or may not be linked to longer term climate change trends. Scientists cannot predict with complete accuracy how climate change will manifest itself locally and what measures to mitigate climate change will be the most effective under local conditions. The situation may no longer be one of profound uncertainty, but it is nevertheless one of profound complexity. Climate change poses risks to humanity but risks that are still for many largely 'virtual' risks rather than real ones, depending on where in the world you live and on how much you can 'afford' to think about these issues. In this context, 'people are thus liberated to argue from, and act upon, pre-established beliefs, convictions, prejudices, and superstitions'.[8] Communicating virtual risks such as climate change, therefore poses challenges to a variety of interested parties such as governments, businesses, non-government organizations (NGOs) as well as a new breed of risk communication consultants,[9] not to mention academic researchers.[10] All types of communicators, therefore have to be able to understand and evaluate both scientific and cultural discourses of climate change.

In this regard, Hulme[11] argues that the task of communicating about climate change goes beyond making people aware of what he calls 'lower case climate change', i.e., climate change as a physical reality:

> At [the] point [where we have achieved clear and effective science communication] we have only just started on the task required. There is also an upper-case "Climate Change" phenomenon: Climate Change as a series of complex and constantly evolving cultural discourses. We next need to embark on the much more challenging activity of revealing and articulating the very many reasons why there is no one solution, not even one set of solutions, to (lower-case) climate change. [...] The role of Climate Change I suggest is not as a lower-case physical phenomenon to be "solved". We need to use the idea of Climate Change-the matrix of power relationships, social meanings

and cultural discourses that it reveals and spawns-to rethink how we take forward our political, social and economic projects over the decades to come.

Climate change communication, thus, itself becomes a very complex undertaking. This complexity is a double one, based on the complexity of climate change itself and on the complexity of the communication that is involved. In this respect, climate change communication shares features with various other communication enterprises, most importantly, risk communication,[10,12] health communication,[13,14] and science communication.[15,16] Climate change communication is, therefore also steeped in various disciplinary traditions with social and cognitive psychology on the one hand, which studies attitudes to risk, strategies that can be used to trigger behavior change, mental barriers, and predispositions, and, on the other hand, communication studies and social studies of science, which investigate the interactions between scientists, the media, policy makers, and stakeholders. The social sciences have come relatively late[17] to the climate change debate, and authors are still exploring what kinds of links may be there. This has ranged from attempts to examine the efforts of key sociologists to engage with the issue,[18] to conferences designed to evaluate the role of the social sciences in addressing the epistemic, political, developmental, and public challenges set by climate change.[19]

In this context, there have been ongoing attempts to rethink the relationship between governments, policymakers, and citizens. Rather than merely being voters, the notions of deliberative democracy or discursive democracy see the public as having a vital role in debating, deliberating, and shaping issues.[20,21] At the same time, critics of the planning process have pointed out that environmental planning is seldom a purely technical, rational process[22] and the purported rationality of many policies is argued to be a cloak for the operations of power.[23]

Consequently, thinking about how climate change is communicated also invites us to consider important questions about how societies work and the kinds of relationship which exist between the various actors in these complex systems. Knowledge and action emerge from ideas, practices, discourses, and perceived risks as much as from technical assessments of environmental quality. In attempting to make sense of complex, systemic relationships such as these, Sheila Jasanoff has promoted the notion that technology and science co-produce each other.[24] Technology affords new forms of sociality, and novel social arrangements facilitate the progression of technology in new directions and into new fields. As the social science of climate change is still in its early stages, it

is not yet clear how these perspectives will play out in this particular field and what this might mean for climate change communication.

Accordingly, this review will deal with some aspects of the theory and language of climate change communication. We will concentrate primarily on issues pertaining to Europe and North America, including the scope of climate change communication efforts, and the types of communication found in this field, before finally reviewing some aspects of the language of climate change communication itself. Inevitably our scope will be selective and we will sadly have to leave out a number of developing debates, for example, concerning the role of NGOs in developing nations, campaigns for environmental justice or questions of technology transfer between nations.

SCOPE OF COMMUNICATION

Information, Awareness Raising, Concern, and Response (Behavior Change)

This section deals with the complex interplay between giving information about climate change, mainly via the mass media, raising awareness about climate change, and eliciting behavioral responses to climate change messages. In the process some insights from the field of science communication will be used to critically reflect on issues pertaining to climate change communication.

The intersection of mass media as the predominant information channel, climate change science, and policy is a dynamic arena in the field of communication studies. Mass media representations may affect how translations between science and policy shape public perception of global climate change. It is, therefore important to consider the role of the media in climate science and policy, and media portrayals of climate change.[25] At the same time, media messages are interpreted and assimilated differently depending on factors such as educational level, television watching, newspaper readership,[26,27] and increasingly in the present day participation in interactive web based facilities.[15] Increasingly, information spread and information gathering based on these technologies are being used to support the communication work carried out by environmental and climate change activists and NGOs. More research into the language they use and the discursive tools they employ is needed. In the following, we shall provide an overview of recent work on climate change communication in the media and discuss this in the context of developments in science communication.

Over the years, a number of media analyses have contributed to the wider study of how climate change risks are constructed by different publics and how such constructions translate into individual or collective action.[28] Pioneering work by Trumbo[29] and Weingart et al.[30] traced the influence of the news media in, respectively, the framing of climate change in the United States and in shaping discourses about climate change (in Germany). In a series of more recent studies, Boykoff and Boykoff,[31] Boykoff,[32,33] Boykoff and Rajan[34] discussed the pernicious influence of the journalistic norm of balance in the coverage of 'global warming' in the US prestige press which can lead to bias. Smith[35] has critically examined the role of the media in constructing public perceptions of climate risk. Other studies looking at construction of climate change risks have drawn upon social and behavioral psychology[36,37] and the communication sciences.[38–40]

Changes in the conception of science communication have contributed to re-thinking climate change communication as well. In the 1980s, many scientists and policymakers subscribed to a view, sometimes called the 'public understanding of science model' in which the public was seen as being in need of education from experts[41] and that knowledge and consensus would increase as a result of more effective public engagement on the part of scientists.[42] However, social scientists challenged the key assumptions underlying this model: that giving laypeople more information about science would necessarily promote the acceptance of scientific and technological advances and lead to greater convergence between the knowledge and attitudes of laypeople and experts. Expert pronouncements seem more likely than ever to be scrutinized and questioned by the mass media, NGOs, branches of government, and concerned members of the public. Distrust accompanies broad social changes, which heighten an appreciation of risk and question our relationship to the expert institutions of modernity.[43,44] In addition, policy itself is not a coherent or consistent whole. As Nye and Rydin[45] point out, policymakers themselves are often to be found struggling for conceptual tools to make sense of the environment and to evaluate the means of minimizing any adverse impact upon it from human activity.

The 'public understanding of science model' entrains a conduit metaphor of communication and assumes deficits of knowledge and understanding on the part of the public.[46,47] However, messages are seldom transmitted in a linear fashion from those who know to those who have deficit knowledge. By contrast, communication is usually grounded in

dialogue and contextual understanding and while laypeople may perhaps know less about science *per se*, they still have a good understanding of the social and political function of science in society, i.e., they have, what one might call good ethical antennae. Criticism of the outdated psychological 'information deficit model' is a common feature of the communication studies surveyed by us for this review.[48] The 'deficit model' assumes that the public are 'empty vessels' waiting to be filled with useful information upon which they will then rationally act.[49] This kind of thinking underlies recent popular treatises such as *Nudge*[50] where ordinary people are seen as being poor decision makers unless 'nudged' to make the correct, expert-approved choice as a result of expert manipulation of their apparent 'choice architecture'.

Rejecting these simplistic views of audiences, critics argue for an approach based on a better understanding of how to engage people at an affective, emotional level, for example, through exploration of bottom-up, non-expert climate perceptions rather than top-down, expert understandings. Indeed, the notion of expertise itself has been dissected and the distinction between expert and non-expert has been problematized.[51] This is associated with a desire to study public perceptions to reveal deeper reasons why we disagree about climate change[52] in line with the deliberative democracy model described earlier. In addition, it is also valuable to consider the way in which experts construct and imagine the public in devising their communication strategies.[53] In other words, just like science communicators, climate change communicators are urged to move from one-way communication to dialogue and reflexive engagement.

In their attempts to engage people with climate change mitigation issues, communicators should consider not only how to encourage rational public engagement with the climate change issue but also how to make the issue appealing, interesting, and meaningful to the individual. Several communication studies, therefore point out that communicators of climate change should aim to achieve meaningful engagement in all three facets: understanding, emotion, and behavior. According to Ockwell et al.[48] existing communication approaches often fail to meaningfully engage, as they do not consider the implicit values, emotions, and attitudes of individuals. The World Wildlife Fund report[54] *Weathercocks and Signposts* advocates that those desiring change need to engage with people's important values and sources of identity, rather than merely appealing to their short term interests. For example, the rational reasoning approaches that utilize messages linking energy reduction to save money do not necessarily foster affective engagement with climate change or address prevailing cultural values or social norms such as using cars for transport even when walking or cycling is feasible.

In a similar vein, Carvalho and Burgess[55] argue for a cultural perspective to be brought to bear on studies of climate change risk perception. Developing the 'circuit of culture' model, the authors maintain that the producers and consumers of media texts are jointly engaged in dynamic, meaning-making activities that are context-specific and change over time in UK newspaper reports from 1985 to 2003. Three distinct circuits of climate change were detected which are characterized by different framings of the associated risks. In the early circuit, from 1985 to 1990, journalists and politicians began to construct the notion of climate change risk, interest in which was boosted by a landmark speech by UK premier Margaret Thatcher, at the Royal Society in 1988. The second circuit occurred in the early 1990s and involved climate change receding from the public debate. The third circuit, from 1997 to 2003 involved enhanced coverage of impending climate change danger. As the *Guardian* reported in 2003: 'Warning voices, carrying the threat of a future dystopia, are becoming clearer and more insistent... Two weeks ago Sir John Houghton, the former head of the Met Office, compared climate change to a weapon of mass destruction'.[55] Carvalho and Burgess infer that there is evidence of social learning as actors build on their experiences in relation to climate change science and policy making. Olausson[56] notes how mass media coverage of climate change issues is largely consonant with the concerns of policymakers, and that, at least in Scandinavia, there is little acknowledgement of uncertainty.

Overall then, many studies have shown that for communication to be effective in terms of raising awareness and promoting active engagement, providing more or better information is not enough. The conduit model of communication does not work. In this context it might be fruitful to revisit a more complex model of communication developed in the 1930s by the German psychologist Karl Bühler.[57,58] His model focused on more than just the transmission of information function of communication. For him '[l]inguistic signs function in the commerce among human beings as instruments that guide practical behavior, they are *signals* used in social life'.[57] Every sign is at one at the same time a symptom (indicator, index) by virtue of its dependence on the sender (whose internal state it expresses), a signal by virtue of its appeal to the recipient (whose behavior it controls), and a symbol by virtue of its assignment

to the objects and states of affairs (to which it refers). And so every sentence is at the same time expression, appeal, and representation. Applied to climate change communication one can observe that much effort and research has gone into honing the 'appeal' function of language. Communicators seem to agree that efforts have to be made to change people's behavior. Similarly researchers have studied how climate change communication can be aligned with the internal states of speakers and hearers, and can express emotions and values. Less research has perhaps been directed at the representational function. What do we actually say about the world when we communicate about climate change? Obviously we want to say that climate change and global warming are 'states of affairs'. But it is difficult to communicate what exactly these states of affairs are because they are very complex. Awareness of climate change has been raised, information has been provided, advice has been given, but acting on it in this context is a difficult decision to make for individuals, communities, and governments around the world.

On the whole, there is no direct correlation between communication and behavior change. There is no one-size that fits all solution. What is needed is a mix of measures of which communication is only one, and it will only work when it is embedded in other approaches which are more directly linked to practical behavior in social life. Communication also has to use a mixture of modes and strategies, from verbal to visual, from the spoken word to the digital message. Communicators can only be sure that their messages will be understood if they understand their audiences, their values, fears, hopes, and the situation of communication. As a document on communication and behavior change developed by the Foreign and Commonwealth Office has recently pointed out, communication can only lead to behavior change if it is 'made to measure', so to speak.[59] However, while individually tailored and multi-modal communication strategies are important in engaging people with climate change, the recommended behavior can only readily be 'performed' when supported by novel government financed initiatives such as easy ways to dispose off your old energy efficient light bulbs that contain mercury, or cheaper and less bureaucratic access to solar panels, to give only two examples. In other words, individual actions need to be supported by broader changes in infrastructure and removal of institutional constraints which are important barriers to low-carbon behavior change.[48]

TYPES OF COMMUNICATIONS

Government-Initiatives and Citizen Communicators

This section provides a critical overview of some, but by no means all, types of communications provided by different types of actors, from government agencies to citizens themselves, including children and local communities.

When dealing with issues of communication, it is instructive to follow Flint's[60] adage for journalism students, 'who, what, where, when and why', or its reformulation for communication scholars by Lasswell[61] as 'Who communicates what in which channel to whom with what effects?' Many *actors* are involved in communicating about climate change to a variety of other actors: governments, citizens, communities, NGOs, businesses, international organizations, celebrities, risk communication consultants, and so on. When communicating between each other, these actors try to achieve different things, such as raise awareness, persuade people to vote for a political party, support government policies, 'save the planet', 'greenwash' a business, expand a business into new and more profitable arenas, and many more. Inside what one can call the climate change community communication processes are at work between those interested in sustainable food production, alternative energy supplies, water, social justice, local or global health, new technologies such as carbon capture and storage, and so on. Thus, climate change communication involves entities and couplings which are far from simple and entail many reciprocal dependent relationships. Communication can also be achieved by using a wide variety of *channels* and media, from text and talk, images,[62] and artistic installations, to films, documentaries, and fun activities for children. Indeed, children as actors and their 'pester power' have been identified as key to initiating attitudinal and behavioral change in the United Kingdom.[63,64]

Governments around the world have begun to pride themselves in engaging citizens with climate change and have themselves become prime actors. However a good deal still needs to be done as only global action and collaboration between actors can deal with the problems posed by climate change. Communication plans have proliferated, but here we will confine ourselves to some remarks about the UK, where the lead is taken by the Department for Environment Food and Rural Affairs (DEFRA) and the Department of Energy and Climate Change.

Government communication campaigns, such as the strategy adopted in the United Kingdom, especially by DEFRA, tend to be driven by three

expectations: (1) to raise awareness;[65] (2) to promote engagement and understanding through public and community participation;[66,67] and (3) to motivate behavior change[56] (see end of previous section). In line with much contemporary government practice, this involves partnerships between government departments, government-sponsored companies, such as the Carbon Trust (http://www.carbontrust. com), the charitable and non-profit sector, such as the Centre for Sustainable Energy (http:// www.cse.org.uk) and the Energy Saving Trust (http://www.energysavingtrust.org.uk), as well as the commercial sector with agencies such as Futerra (http://www.futerra.co.uk) who specialize in communication. Futerra, for example, has been commissioned by DEFRA to undertake such tasks as assessing public opinion, and recommending strategies for attitudinal and behavioral change. The alliance also includes scientific advisors with a strong public profile such as Bob Watson, previously the World Bank Chief Scientist and Senior Advisor for Sustainable Development, and David King, head of the Smith School of Enterprise and the Environment at Oxford University, during his recent period as head of the Government Office for Science (2000–2007).

Futerra has compiled a series of reports, for example, detailing their recommendations on climate change strategy,[68] their views on effective communication strategies,[69] as well as commentary on a variety of means of measuring attitudes and behavior.[70] This series of documents brings together recent evidence on the public's understanding of 'climate change' and related terms.[71] The public, says Futerra, while strongly aware of climate change issues and terminology, tend to believe that climate change will not affect them personally even though they see climate change as linked to human behavior. In the West, climate change is generally perceived as something which mostly affects other parts of the world, and which will have profound effects on future, not current, generations, although recent billboard campaigns by Oxfam have tried to dispel this image. As Rydin[72] reminds us, people's own forms of knowledge are often highly specific and partial, and the challenge for policymaking is to integrate and speak to these specific and often incomplete forms of knowledge held by different sections of the population. Consequently, it is recommended that effective climate change communications balance off the need to engage the public on their own level against the need to inform them of key facts and concepts. Recommendations also stress the need not merely to invoke fear but give people a sense that there is something they can do about it, the importance of engaging social networks and opinion leaders, and the value of a consistent message from policymakers.

Government communications strategies in the United Kingdom have involved a variety of other initiatives to build awareness and participation, using the kinds of brand management strategy pioneered in the commercial sector. The launch of the 'brand' 'Save Money, Save Energy, ACT ON CO_2', took place in 2007 (http://campaigns.direct.gov.uk/actonco2/home. html) involving individualized invitations to calculate one's personal carbon footprint, offering personal financial incentives (e.g. currently, a package of assistance to households to help them tackle rising energy prices and save 'up to £300 every year') as well as longer term strategies such as 'carbon offsetting'. Communication is also a central and complex part of the process of achieving integrated assessment in the UK Climate Impacts Programme (UKCIP)—http://www.ukcip.org.uk. This programme was established to engage stakeholders directly in assessing the impacts of climate change by enabling them to undertake research which served their needs for information for adaptation. The implicit aim has, therefore been to work with partners rather than communicate to external parties. An explicit aim is that by providing an integrative framework within which studies are undertaken, individual sectors will obtain a more realistic assessment of climate change impacts.

Paradoxically, research suggests that people see governments as responsible for addressing environmental problems, yet have little faith that they will.[73,74] Some have blamed the inconsistency of government messages for that, for example, while low fuel prices are emphasized, and increases resisted, people are exhorted to change their behavior.[75] There is also some discussion about which kinds of behavior are worth encouraging. Popular advice to unplug phone chargers may achieve little, even if the audience complies. As Cambridge Physics Professor David MacKay claims:[76] 'Obsessively switching off the phone-charger is like bailing the Titanic with a teaspoon. Do switch it off, but please be aware how tiny a gesture it is. All the energy saved in switching off your charger for one day is used up in one second of car-driving'.

There is an ongoing interest in the views of *children and young people as potential innovators and motivators* of household change which has resulted in the agency LVQ Research[77,78] being commissioned to assess their awareness and attitudes. Climate change is often described as a generational issue. Consequently, educational and continuing education organizations ranging from secondary schools to colleges and universities are seen as having important roles to play

in the effective communication of responsible climate change science and policy developments.[79]

In contrast to centrally organized communication initiatives, however, in recent years, new movements have emerged in a bottom-up manner. These community-based movements stand in a long tradition of environmental activism and voluntary rather than government-led action. There has been increasing citizen interest in establishing carbon reduction groups or low-carbon communities. These groups meet locally but are also very effective users of modern communication technologies, from websites to web fora to online journals or 'blogs' and the so-called 'micro-blogging' service Twitter. A whole new language is emerging[80] in these groups, which centers around carbon reduction or low-carbon living. This language overlaps to some extent with the language used on government websites that exhort people to reduce their 'carbon footprints' as well as with ethical lifestyles promoted by the media and advertisers. Two of the most prominent community-based programmes are perhaps http://lowcarboncommunities.net/ and http://lowcarboncommunity.org/, as well as http://www.carbonrationing.org.uk.[81] For example, in the future it would be interesting to compare and contrast media coverage of government-sponsored climate change communication and the communication of climate change by activists. Here, the idea of an active polity of citizens deliberating and debating issues, generating their own languages and concepts and deploying new means of communication invokes the ideas in deliberative democracy studies.[82]

As there is much evidence for the growing contemporary importance of peer-to-peer, rather than top-down, influence, climate change communication scholars also have to look at how the local authorities and groups engaged in climate-related activities on the ground construct and talk about the issues and their own actions. There are many examples of very local activities, down to village or street level. Of particular note, especially from the point of view of notions of active, thinking citizens, is the 'Our Footprint Our Journey' communication campaign led by *Fifth Pictures* and the *Times Education Supplement* for the village of Ashton Hayes. In collaboration with the University of Chester, Ashton Hayes aims to become 'England's first Carbon Neutral village' (http://goingcarbonneutral.co.uk). A further example is 'Exposed! Climate Change in Britain's Backyard' led by the UK's *National Trust*. By applying the fine art of photography to illustrate how a global challenge is having a damaging local impact, the *National Trust* managed to bring climate change to life for its own visitors as well as for a wider arts community.

This illustrates the role of charitable, voluntary, and NGOs in exploring novel, artistic or creative ways of communicating on these issues which differ from the more didactic approaches favored by official bodies.

THE ROLE OF LANGUAGE

Language may Lock us into Certain Ways of Defining, Thinking, or Interpreting Climate Change

Investigations of climate change communication cannot avoid attending to the role of language. Using a combination of methods derived from discourse analysis and semiotics, two seminal studies by Ereaut and Segnit[83,84] identified a number of 'linguistic repertoires' defined as loosely coherent lines of talking and thinking about climate change. Such repertoires are influential because they offer a range of resources from which people—consumers, journalists, politicians, and others—can construct their own arguments about climate change and which may lead to different 'logical' conclusions about the need for behavior change. Each of the repertoires identified in *Warm Words*[83,84] were found to be 'visible to some degree' in media discourse at the time, while the 'alarmism' and the 'small actions' repertoires were found to be dominant. The authors also discussed how the task of behavior change might be framed in the light of the discursive context they described.

Ereaut and Segnit[84] suggest that there are lessons to be learned from locally organized initiatives. As these initiatives use the rich, imaginative, and playful language of popular culture, media, and everyday discourse, rather than the discourses of politics, campaigning, and the public sector, they may be a useful route to engage people on the emotional level. The authors also found the emergence of a new, more positive and energetic lexicon of climate change in these communications. Consequently, they maintain that: 'By harnessing the latent power of locality, interested organizations could begin to close the gap between the official consensus on climate change and the public's willingness to do something about it'.[82]

The use of alarmism in climate change communication has been much discussed in recent years,[10] as research has shown that it might have the opposite effect to what was intended.[85,86] Nevertheless, using distress appeals as a way of motivating attitude change and re-programming sceptics is still advocated by some commentators.[87] Futerra[69] advocates that a fear appeal should be used only if a credible way out of the problem is also presented. Equally, it is

suspected that processes of habituation and desensitization could reduce people's attention to news about impending catastrophes. Accordingly, the UK's *Guardian* newspaper held a conference entitled *Fighting Climate Change Fatigue*.[88]

An increased attention to the role of language and communication is urged upon scientists by many commentators. In a variety of papers and initiatives reminiscent of the public understanding of science model described above, scientific communicators are encouraged to adapt their language to suit the tastes, meanings, and concerns of ordinary people. For example, in a short but spirited article Hassol[89] describes several such techniques whereby scientists can communicate in terms akin to those understood by putative members of the public.

Using Metaphors

Hassol[89] suggests using metaphors and embedding these in stories. For example, the metaphor of age can be used to describe the difficulty of relating climate to weather. Although it is impossible to predict the age of death of any particular person, we can say with confidence that the average age of death for people in the United States is 77. She goes on to point out that climate, like the average age of death, is a statistical average that is predictable based on large-scale forces, while weather is subject to chaotic forces that make it inherently more difficult to predict: 'How can scientists respond when people say that climate has always changed, so the current warming is probably also natural? A good metaphor that reveals the fallacy of this thinking is that just because lightning strikes have long caused forest fires does not mean fires cannot also be caused by a careless camper. And of course, there are many lines of evidence that show that the current warming is due primarily to human activity. The ever popular metaphor of loaded dice provides a good response to the question of how global warming is affecting various weather phenomena. When people ask if global warming is responsible for the recent streak of heat waves, floods, wildfires, and intense hurricanes, you can say that by loading the atmosphere with excess greenhouse gases, we are loading the dice toward more of these extreme weather events. The data show this is already occurring for many phenomena; and models have long projected these changes'.[89] At the same time, as we have noted before, scientific communication is about rather more than simply well chosen metaphors. As Wynne[46] notes, these themselves can be read back to disclose how scientists conceive of the public. Indeed, this preoccupation with finding the language of the common man or woman as a vehicle of public engagement is

perhaps the latest manifestation of the older concern that the public is somehow deficient in knowledge.[90]

Words

Faith in the notion that the public would come into alignment with scientific opinion if only the right communication were used can also be seen in the preoccupation with finding the right words. As Hassol[89] describes it 'Scientists use many words that mean something very different to much of the public. For example, scientists frequently use the word "enhance" to mean increase, but to laypeople, enhance means to improve or make better, as in "enhance your appearance." So the "enhanced greenhouse effect" or "enhanced ozone depletion" sounds like a good thing. Try "intensify" or "increase" instead. "Positive" connotes good and "negative" connotes bad to non-scientists. So "positive trends" or "positive feedbacks" sound like good things. Instead of "positive trend," try "upward trend." Instead of "positive feedback," try "self-reinforcing cycle." "Radiation" is about X-rays and Chernobyl for much of the public; try "energy" instead. "Fresh" means pure and clean, like fresh-smelling laundry; so instead of saying water will become "fresher," try "less salty."' According to this view, alignment between the public and the putative scientific consensus will be enhanced if more colloquial language is adopted, in recognition of variations in meaning across social groups. Once again, however, in this view, the scientific framing of the issue and the public's ignorance is taken for granted and the stage is set for the kind of manipulation of publics to a scientific agenda described by Cooke and Kothari.[91] Instead, say Feldt and Wynne[92] it might be possible to conceive of a different model of communication and engagement which allows a more dynamic relationship to develop and enables participants to 'challenge entrenched assumptions, interests, power-structures, and imaginations' and more fully cognizant of the capabilities of people to deliberate, discuss and deduce solutions independent of government interventions.[93]

Strategies

The assumptions of the old public understanding of science model can also be found at work when authors speak of strategies for communication. From the enthusiasm which greeted *Nudge*, the ground rules for communication, steeped in a tradition of attitude change, described by Futerra[68] to contemporary reviews of 'effective strategies', a model of the public is encoded as a body of people in need of enlightenment and persuasion by the 'experts'.

Some popular strategies were summarized in a paper by Thompson and Schweizer.[1]

1. Know your audience and select a credible messenger for that audience.

2. Know what type of claim, argument you are asserting and why it is appropriate for your audience.

3. Connect your message to cultural values and beliefs; people react to traditions, experiences and shared values—not abstract concepts and scientific data.

4. Make the message meaningful; appeal to values that are meaningful for your audience. For example, speak in spiritual language and parables when targeting a conservative Christian audience.

5. Lead with your strongest argument or your most confident point.

6. Make the message empowering; tell your audience what specific actions they can take to make a difference.

7. Link to global patterns and collective action; promote a 'systems' perspective of the problem and of potential solutions.

8. Partner with other organizations, key players, leaders, employees, rock bands, and neighbors.

9. Start from the inside—get your organization's top leaders involved, inspire action internally first, then communicate about it.

10. Communicate about actions and remember that actions and events are an effective mode of communication.

Once again, despite gestural references to 'systems' and 'empowerment', the drift of this list of strategies implies that it is generally the public which needs to be informed by experts. This, as Felt and Wynne[92] describe, suggests that 'interest seems focused on new procedures more to justify established imaginations and commitments, and to procure "trust" for what remain essentially unchanged imaginations, habits-of-thought and decision-making processes'. It reflects 'persistently technocratic, reductionist and exclusive functioning of the underlying governance culture itself'. Felt and Wynne remain optimistic that a more effective and creative dialogue is possible, with the recognition that science and government are part of the very societies they seek to control. 'By "opening up" the ways in which the "answers" depend on the "questions" and the framing of analysis, this would in itself facilitate the nurturing and maturing of more open and diversely creative discursive spaces on the roles and purposes of science in governance'.[92]

New Language of Climate Change

Policy makers, climate scientists and social scientists are all grappling with complex and dynamic feedback mechanisms that operate between the economy, society and the ecosystem. Language is part of this dynamic system and has developed a dynamics of its own in relation to climate change. Whereas the 20th century was the century of 'the gene' whose meaning has been studied by many social scientists (e.g., Condit[94] and Keller[95]), the 21st century will be the century of 'carbon' whose meaning needs to be studied, preferably before we enter the era of 'a post-carbon society'. There is what one may call an explosion of information around climate change. Advice on how to reduce one's 'carbon footprint' is provided almost daily in newspapers, adverts, books, and on websites. This explosion of information is mirrored by an explosion of creativity around the word 'carbon', as much of this advice is framed by using what one might call 'carbon compounds'—lexical combinations of at least two roots—such as 'carbon finance', 'carbon sinner', or 'low-carbon diet'.[96] This new vocabulary of climate change is being studied at present by the authors of this article in collaboration with Mike Thelwall (Wolverhampton) using methods such as discourse analysis, corpus linguistics, metaphor analysis, and cybermetrics. Our aim is to map how climate change is framed by various stakeholders, how public attitudes and perceptions are shaped and what solutions to climate change and global warming are proposed using the conceptual and linguistic tools provided by 'carbon compounds'. At the moment of writing and in the context of the global 'credit crunch', the compounds 'low-carbon technologies' and 'low-carbon economies', for example, seem, to be on the rise, indicating a new willingness, wrought by necessity, to bring human ingenuity to bear on climate change, and not only linguistic, but technological ingenuity.[79,80,96]

We believe that only a conjoint effort in both science and technology and language and culture can bring about changes in behavior and changes in climate. We must have the right messages but we also require the right infrastructure to implement them in everyday life. For this we need governments to foster debate as to what their priorities should be and to offer policies which can integrate energy needs, environmental quality and sustainability in new and ingenious ways in partnership with an informed and active citizenry. In such debates, the conceptual

devices and discursive features used can transform public perceptions and the policies which appear to be desirable, as in Moore et al.'s analysis of the fruitful concept of an 'ecological footprint'.[97] Although policy discourses have come to reflect changes in media discourses and citizen discourses about climate change, policy makers are only slowly going beyond 'mere' communication and discourse toward much more radical involvement and investment in and governance of urban planning, sustainable transport, low-carbon energy, and so on.

CONCLUSION

Assessment of How Communication Could be Improved

Many of the studies reviewed here present what we call 'visions of effective climate change communication' as they draw on such communication maxims as the importance of engaging people emotionally, carefully defining communication goals, engaging people in a dialogue or two way communication model, and knowing one's audiences, for example in the above descriptions of communication strategies. As we have described, and as critics of the public understanding of science model such as Wynne have pointed out, there often exists an implicit model of the audience which may not be subject to empirical scrutiny and which may assume from the outset a degree of ignorance or deficit which is itself not a good perspective from which to begin dialogue. There is often a wish to transmit, educate and inform the public rather than an opportunity to transform decisions and commitments on both sides.

Here we want to stress the importance of the key value in risk communication of undertaking empirical study to plan and evaluate communications. Before any local communication activities take place it is important to survey existing public perceptions about the issue which can be used to tailor communication initiatives.

We would also like to enter a plea for policy-makers, scientists, and communicators to look beyond simple transmission models or public understanding models of the relationship between expert knowledge and 'lay knowledge'. These embody a limited view of the relationships between science and society, a limited view of the public and a curiously truncated view also of communications research as being about finding the right words and checking if people have listened. This places communications scholars in a kind of handmaid role. Instead, perhaps we should consider how the relation between the global and

local impact of climate change is highly complex and culturally determined, that perceptions about climate change are multiply inflected and new ways of thinking about politics, power, and social structure are afforded by discussions of climate change.[52,71] Darier and Schüle[74] found strong similarities in lay public perceptions in two cities, including that (1) awareness of global environmental issues is always contextualized in broader perspectives and is not exclusively 'environmental', (2) there is a shared and strong sense of global equity based on recognition of differences and (3) there is an ambivalence about the role of environmental 'information'. Differences between lay public perceptions about climate change can be influenced by specific features of national cultures. Although qualitative studies of public perceptions cannot directly tell policy makers which specific policy initiatives could work in practice, they can, however, give indications of what is likely to be acceptable to citizens, and more importantly why or why not.

With this in mind, there is no such thing as an effective communication *per se*—in the sense of communication strategies devised in a vacuum, ahead of time, or—like much classic attitude change research—conducted in the laboratory. Ongoing studies of public perceptions and commitments should inform the framing of a message and what it should say. Using this method, Bostrom et al.[98] and Read et al.,[99] for example, examined public understanding and perception of climate change. On the basis of their findings, a communication brochure for the general public was developed and iteratively refined using read-aloud protocols and focus group discussions. More recent studies of public perceptions[100–102] can provide evidence of what people currently know and believe about energy technologies, with the goal of facilitating better communication between all parties in society about the respective risks and benefits of climate change. Lorenzoni and Hulme[103] discussed several future scenarios with participants and elicited a desire on the part of their informants to see more information about how the predictions were derived and the kinds of evidence they were based upon, also uncovering questions of trust in science and a wish to explore the shorter-term local impact of possible changes. Thus, rather than seeing the audience as ignorant or in need of instruction from expert communicators, maybe one way forward is to grasp the possibilities offered by a more deliberative model of the policymaking process. Differences in groups of people's capabilities to make use of opportunities to address climate change may not come about through the ignorance of one group compared to another,

but through historical and political aspects of the operation of power.[23] The kinds of actions that seem to stem from people's knowledge or attitudes are certainly embodied in individuals, but these result from the provision of material powers and resources via the person's social milieu or in their background. Once people become collectively engaged with a task that they have a realistic chance of solving, they can, as the residents of Aston Hayes have demonstrated, acquire knowledge and technologies themselves. This process has been theorized through the notion of discursive or deliberative democracy[21,22] and through the notion that technologies change social relationships and that these in turn modify the technologies.[24]

Psycho-social studies into peoples' perceptions of climate change and climate change mitigation can be complemented by linguistic and discursive analyses. Studying how the competing voices of climate change are framed by various stakeholders in different media (from print media to Web. 2.0) can help gauge public opinions and reactions to the issue of climate change mitigation. Whereas traditional media such as newspapers have been extensively studied, attempts to examine the construction of climate mitigation issues in emergent social groups, blogs and other new media are still relatively rare.[104] These proliferating sites of debate, engagement, and knowledge construction offer new ways of thinking about climate change and its attendant risks. This offers that each case can 'develop its own logic of participation'[92] and new actors such as villages, parish councils, and concerned individuals can develop their own voices and their own ways of harnessing science and technology. A lively debate can best be understood not as a failure of consensus or a deficiency of knowledge but as a means of 'keeping public engagement with science authentically alive and not under the control of agents whose own culturally embedded assumptions, imaginations, and practices may well be part of the problem'.[92]

NOTES

For reasons of space we cannot survey the US climate change 'scene' in this way but one should mention the *Yale Forum on Climate Change and the Media* (http://www.yaleclimatemediaforum.org/index.php) and the *Center for Climate Change Communication* (http://www.climatechangecommunication.org/).

ACKNOWLEDGEMENT

REFERENCES

1. Thompson JL, Schweizer S. The conventions of climate change communication. Paper presented at the *Annual Meeting of the NCA 94th Annual Convention*, TBA, San Diego. [Online] 2008, http://www.allacademic.com/meta/p257413_index.html (Accessed May 3, 2009).

2. Butler P. *Making A Mockery of Global Warming*. *Daily Mail*, 2008, 49.

3. Hitchens. P. The Green fanatics… and a nice little earner Mail on Sunday 2006, London (November 5), 25.

4. Waterhouse K. *So just how green grows the Grauniad? Daily Mail*, 2008, 16.

5. Intergovernmental Panel on Climate Change. *Climate Change 2007: The Physical Science Basis*, Summary for Policymakers Geneva. Switzerland: Intergovernmental Panel on Climate Change; 2007.

6. Anonymous Prepare for a climate-changed world, say engineers, New Scientist, February 21, 2009.

7. Ungar S. The rise and (relative) decline of global warming as a social problem. *The Sociological Quarterly* 1992, 33:483–501.

8. Adams J. *Risk Management: It's Not Rocket Science–It's Much More Complicated Public Risk Forum 2007*. http://www2.sa.unibo.it/docenti/emanuele.padovani/PublicRiskForum_2_07.pdf (Accessed February 10, 2009).

9. Sandman P. Climate Change Risk Communication: *The Problem of Psychological Denial 2009*. http://www.psandman.com/col/climate.htm (Accessed March 10, 2009)

10. Morgan MG, Fischoff B, Bostrom A, Aman CJ. *Risk Communication: A Mental Models Approach*. Cambridge: Cambridge University Press; 2001.

11. Hulme M. *Climate Change: From Issue to Magnifier Open Democracy*. 2007. 19th October. http://www.opendemocracy.net/article/globalisation/politics_protest/climate_change. (Accessed January 26, 2009).

12. McCarthy M, Brennan M, De Boer M, Ritson C. Media risk communication—what was said by whom and how was it interpreted. *Journal of Risk Research* 2008, 11:375–394.

13. Makoul G, Clayman M, Lynch E, Thompson J. Four concepts of health in America: results of national surveys. *Journal of Health Communication* 2009, 14:3–14.

14. Schiavo R. *Health Communication: From Theory to Practice*. San Francisco: Jossey Bass; 2007.

15. Maibach E, Priest SH. No more 'business as usual': addressing climate change through constructive engagement. *Science Communication* 2009, 30: 299–304.

16. Nisbet MC, Kotcher JE. A two-step flow of influence? opinion-leader campaigns on climate change. *Science Communication* 2009, 30:328–354.

17. Rayner S, Malone EL., eds., *Human Choice & Climate Change*. Volume 1: The Societal Framework. Columbus, Ohio: Battelle Press, 1998.

18. Lever-Tracy C. Global warming and sociology. *Current Sociology* 2008, 56:445–466.

19. *Science Studies Meet Climate Change: A Rendezvous with Consequences*. University of Copenhagen, April 2009. http://stsclimate.soc.ku.dk/.

20. Dryzek JS. *Discursive Democracy: Politics, Policy and Political Science*. New York: Cambridge University Press; 1990.

21. Dryzek JS. *Deliberative Democracy and Beyond: Liberals, Critics, Contestations*. Oxford: Oxford University Press; 2000.

22. Fischer F. *Citizens, Experts, and the Environment: The Politics of Local Knowledge*. Durham: Duke University Press; 2000.

23. Flyvbjerg B. *Rationality and Power*. Chicago: University of Chicago Press; 1998.

24. Jasanoff S. *States of Knowledge: The Co-Production of Science and the Social Order*. London: Routledge; 2006.

25. Nisbet MC. Framing science: a new paradigm in public engagement. In Kahlor L, Stout P., eds. *Understanding Science: New Agendas in Science Communication*. New York: Taylor and Francis; 2009, 40–67.

26. Kahlor LA, Rosenthal S. If we seek, do we learn? predicting knowledge of global warming. *Science Communication* 2009, 30:380–414.

27. Kahlor L, Dunwoody S, Griffin R, Neuwirth K. Predicting information seeking and processing in the context of impersonal risks. *Science Communication* 2006, 28:163–194.

28. Lorenzoni I, Pidgeon N, O'Connor R. Dangerous climate change: the role for risk research. *Risk Analysis* 2005, 25:1387–1398.

29. Trumbo CW. Constructing climate change. Claims and frames in U.S. news coverage of an environmental issue. *Public Understanding of Science* 1996, 5:1–15.

30. Weingart P, Engels A, Pansegrau P. Risks of communication: discourses on climate change in science, politics, and the mass media. *Public Understanding of Science* 2000, 9:261–283.

31. Boykoff M, Boykoff J. Balance as bias: global warming and the US prestige press. *Global Environmental Change* 2004, 14:125–136.

32. Boykoff MT. Flogging a dead norm? Newspaper coverage of anthropogenic climate change in the USA and UK from 2003-2006. *Area* 2007, 39:470–481.

33. Boykoff M. Media and scientific communication: a case of climate change. In: Liverman DGE, Pereira CPG, Marker B, eds. *Communicating Environmental Geoscience*. London: Geological Society, Special Publications; 2008, 305:11–18.

34. Boykoff MT, Rajan SR. Signals and noise: mass media coverage of climate change in the USA and the UK. *European Molecular Biology Organisation Reports* 2007, 8:207–211.

35. Smith J. Dangerous news: media decision making about climate change risk. *Risk Analysis* 2005, 25:1471–1482.

36. Leiserowitz AA. The day after tomorrow: a study of climate change risk perception. *Environment* 2004, 46:22–37.

37. Baron J. Thinking about global warming. *Climatic Change* 2006, 77:137–150.

38. Nicholson-Cole S. Representing climate change futures: a critique on the use of images for visual communication Computers. *Environment and Urban Systems* 2005, 29:255–273.

39. Moser SC, Dilling L. *Creating a Climate for Change*. Communicating Climate Change and Facilitating Social Change. Cambridge: Cambridge University Press; 2007.

40. Anderson A. Media, politics and climate change: towards a new research agenda. *Sociology Compass* 2009, 3:166–182.

41. Royal Society *Public Understanding of Science*. London: The Royal Society; 1985.

42. House of Lords Science and Society, Select Committee on Science and Technology, *HL Paper 38*, Session 1999-2000, Third Report, 2000, London.

43. Beck U. *Risk Society: Towards a New Modernity*. London: Sage; 1992.

44. Stilgoe J. The (co-)production of public uncertainty: UK scientific advice on mobile phone health risks. *Public Understanding of Science* 2007, 16:45–61.

45. Nye M, Rydin Y. The contribution of ecological footprinting to planning policy development: using REAP to evaluate policies for sustainable housing construction. *Environment and Planning B: Planning and Design 2008* 2008, 35:227–247.

46. Wynne B. Public uptake of science: a case for institutional reflexivity. *Public Understanding of Science* 1993, 2:321–37.

47. Wynne B. Risky delusions: misunderstanding science and misperforming publics in the GE crops issue. In: Taylor IE, ed. *Genetically Engineered Crops: Interim Policies, Uncertain Legislation*. New York: Haworth Press; 2007, 341–366.

48. Ockwell D, Whitmarsh L, O'Neill S. Reorienting climate change communication for effective mitigation forcing people to be green or fostering grassroots engagement? *Science Communication* 2009, 30:305–327.

49. Irwin A, Wynne B. *Misunderstanding Science? The Public Reconstruction of Science and Technology*. Cambridge: Cambridge University Press; 1996.

50. Thaler R, Sunsteen C. *Nudge: Improving Decisions About Health, Wealth and Happiness*. Newhaven: Yale University Press; 2008.

51. Collins H, Evans R. *Rethinking Expertise*. Chicago: University of Chicago Press; 2007.

52. Hulme M. The conquering of climate: discourses of fear and their dissolution. *The Geographical Journal* 2008, 174:5–16.

53. Wynne B. Uncertainty and environmental learning – reconceiving science and policy in the preventive paradigm. *Global Environmental Change* 1992, 2:111–127.

54. WWF. *World Wildlife Fund Weathercocks and Signposts: The Environment Movement at a Crossroads*. London: World Wildlife Fund; 2008.

55. Carvalho A, Burgess J. Cultural circuits of climate change in UK broadsheet newspapers, 1985-2003. *Risk Analysis* 2005, 25:1457–1469.

56. Olausson U. Global warming—global responsibility? Media frames of collective action and scientific certainty. *Public Understanding of Science* 2009, 18(4):421–436.

57. Bühler K. The origin of language. *Psychological Bulletin* 1928, 25:169–170.

58. Bühler K. *Sprachtheorie: Die Darstellungsfunktion der Sprache* Jena: Gustav Fischer; 1934.

59. Bird C. *Strategic Communication and Behaviour Change: Lessons from Domestic Policy*. Foreign and Commonwealth Office; 2009.

60. Flint LN. *Newspaper Writing in High Schools, Containing an Outline for the Use of Teachers*. Kansas City: Department of Journalism Press, University of Kansas; 1917.

61. Lasswell H. The structure and function of communication in society. In: Bryson L, ed. *The Communication of Ideas*. New York: Harper and Brothers; 1948, 37–51.

62. Doyle J. Picturing the clima(c)tic: greenpeace and the representational politics of climate change communication (1994-present). *Science as Culture* 2007, 16:129–150.

63. O'Neill B. March of the Pint Sized Eco-Nazis: They Moan if you Leave the Lights on, Whine if You don't Recycle and Nag you for not Using Lead-Free Fuel. What is happening to our children? *Daily Mail*, November 27, 2008, 72.

64. van der Zee B. *Pester Power: More and More School Children are Promoting the Green Message - Including Badgering Parents about Turning off Lights and Shunning Cheap Holiday Flights Guardian*. [Online] 2007, http://www.guardian.co.uk/environment/2007/feb/01/schools.ethicalliving (Accessed March 7, 2009).

65. DEFRA Action in the UK. *Public Attitudes to Climate Change*. 2009a. http://www.defra.gov.uk environment/climatechange/uk/individual/attitudes/index.htm (Accessed March 7, 2009).

66. DEFRA Action in the UK. *Individual and Community Action*. 2009b. http://www.defra.gov.uk/environment/climatechange/uk/individual/summit/index.htm (Accessed March 7, 2009).

67. DEFRA Action in the UK. *Individual and Community Action Community Initiatives and Individual Behaviour Change*. 2009c. http://www.defra.gov.uk/environment/climatechange/uk/individual/community/index.htm (Accessed March 7, 2009).

68. Futerra *UK Communications Strategy on Climate Change*. London: Futerra Sustainability Communications Ltd., 2005a.

69. Futerra: *The Rules of the Game: Principles of Climate Change Communications*. London: Futerra Sustainability Communications Ltd., 2005b.

70. Futerra *Measurement*. London: Futerra Sustainability Communications Ltd., 2005c.

71. Whitmarsh L. What's in a name? Commonalities and differences in public understanding of "climate change"and "global warming" *Public Understanding of Science* 2009, 18(4):401–420.

72. Rydin Y. Re-examining the role of knowledge within planning theory. *Planning Theory* 2007, 6:52–68.

73. Burgess J, Harrison CM, Filius P. Environmental communication and the cultural politics of environmental citizenship. *Environment and Planning A* 1998, 30:1445–1460.

74. Darier E, Schüle R. Think globally, act locally? Climate change and public participation in Manchester and Frankfurt local environment. *The International Journal of Justice and Sustainability* 1999, 4:31–329.

75. Owens S, Driffill L. How to change attitudes and behaviours in the context of energy. *Energy Policy* 2008, 36:4412–4418.

76. MacKay DJC. *Sustainable Energy Without the Hot Air*. Cambridge: UIT Cambridge Ltd; 2008.

77. *LVQ Research Attitudes to Climate Change Amongst Young People – Wave 2*. London: Central Office of Information; 2008.

78. *LVQ Research Attitudes to Climate Change: Youth Sample*. London: Central Office of Information; 2006.

79. Ward B. *Communicating on Climate Change*. An Essential Resource for Journalists, Scientists, and Educators. Metcalf Institute for Marine and Environmental Reporting; 2008. http://www.metcalfinstitute.org/Communicating_ClimateChange.htm (Accessed October 2, 2009).

80. Nerlich B, Koteyko N. Compounds, creativity and complexity in climate change communication: the case of 'carbon indulgences'. *Global Environmental Change* 2009, 19(3):345–353.

81. Nerlich B, Koteyko N. Carbon reduction activism in the UK: Lexical creativity and lexical framing in the context of climate change. *Environmental Communication* (in press) (special issue on Climate Change Discourses, edited by A. Carvarlho and TR Petersen) 2009, 3(2):206–223.

82. Hajer MA, Wagenaar H. *Deliberative Policy Analysis. Understanding Governance in the Network Society* Cambridge: Cambridge University Press; 2003.

83. Ereaut G, Segnit N. *Warm Words: How Are We Telling the Climate Story and Can We Tell it Better?* London: Institute for Public Policy Research; 2006.

84. Ereaut G, Segnit N. *Warm Words II: How the Climate Story is Evolving and the Lessons We Can Learn for Encouraging Public Action*. London: Institute for Public Policy Research; 2007.

85. Stiff JB, Mongeau PA. *Persuasive Communication*. New York: Guilford Press; 2009.

86. Witte K, Allen M. A meta-analysis of fear appeals: Implications for effective public health campaigns. *Health Education and Behaviour* 2000, 27:591–605.

87. Moffic HS. Can psychiatric approaches help to address global warming? *Medscape General Medicine* 2007, 9:2.

88. *Guardian Fighting Climate Change Fatigue: How to Keep Stakeholders Engaged*. 2008. http://environment.guardian.co.uk/climatesummit/page/0, 2274295,00.html (Accessed July 3, 2009).

89. Hassol SJ. Improving how scientists communicate about climate change Eos. *Weekly Journal of the American Geophysical Union* 2008, 89:106–107.

90. Wynne B. Public engagement as a means of restoring public trust in science – hitting the notes, but missing the music? *Community Genetics* 2006, 9:211–220.

91. Cooke B, Kothari U (eds.) *Participation: The New Tyranny?* London/New York: Zed Books; 2001.

92. Felt U, Wynne B. *Taking European Knowledge Society Seriously*. Report of the Expert Group on Science and Governance to the Science, Economy and Society Directorate, Directorate-General for Research, European Commission. Luxembourg: Office for Official Publications of the European Communities; 2007.

93. Scrase I, MacKerron G. *Energy for the Future, A New Agenda*. Basingstoke: Palgrave; 2009.

94. Condit C. *The Meanings of the Gene: Public Debates About Heredity*. Madison: University of Wisconsin Press; 1999.

95. Keller EF. *The Century of the Gene* Cambridge, MA: Harvard University Press; 2000.

96. Nerlich B, Koteyko N. Carbon gold rush and carbon cowboys: A new chapter in green mythology? *Environmental Communication* (in press).

97. Moore S, Nye M, Rydin Y. Using ecological footprints as a policy driver: The case of sustainable construction planning policy in London. *Local Environment The International Journal of Justice and Sustainability* 2007, 12:1–15.

98. Bostrom A, Morgan MG, Fischhoff B, Read D. What do people know about global climate change? *Risk Analysis* 1994, 14:959–970.

99. Read D, Bostrom A, Morgan MG, Fischhoff B, Smuts T. What do people know about global climate change? Survey results of educated laypeople. *Risk Analysis* 1994, 14:971–982.

100. Lorenzoni I, Pidgeon N. Public views on climate change: European and USA perspectives. *Climatic Change* 2006, 77:73–95.

101. Pidgeon N, Lorenzoni I, Poortinga W. Climate Change or nuclear power – No thanks! A quantitative study of public perceptions and risk framing in Britain. *Global Environmental Change* 2008, 18:69–85.

102. Spence A, Pidgeon N, Uzzell D. Climate change –psychology's contribution. *The Psychologist* 2009, 21:108–111.

103. Lorenzoni I, Hulme M. Believing is seeing: Laypeople's views of future socioeconomic and climate change in England and in Italy. *Public Understanding of Science* 2009. 18(4):383–400.

104. Koteyko N, Thelwall M, Nerlich B. *From carbon markets to carbon morality: creative compounds as framing devices in online discourses on climate change mitigation. Science Communication* (in press).