Communicating climate change: history, challenges, process and future directions

Susanne C. Moser*

most other, more familiar problems, yet which also has the potential for far graver implications than previous challenges. According to the current scientific understanding, climate change could undermine the life support system of many species, even significantly reduce the numbers of our own, and bring profound changes, challenges, and harm to societal systems.[3–5] It also requires unprecedented cooperation, innovative policies, novel technologies, difficult trade-offs, and new ways of thinking and behaving to be addressed adequately and appropriately.[6–9] What is known, presumed, and still unknown about how to effectively communicate a problem of such gravity and complexity is the focus of this paper.

Since anthropogenic climate change first emerged on the public agenda in the mid-to-late 1980s, public communication of climate change and—more recently—the question of how to communicate it most effectively have witnessed a steep rise. Much of the early communication was relatively narrowly focused on scientific findings and synthesis reports (such as those published periodically by the Intergovernmental Panel on Climate Change, IPCC), sometimes occasioned by particularly severe extreme events, sometimes by high-level conferences or policy meetings.[10] But the implications of climate change were soon recognized as potentially pervasive and profound across world regions and economic sectors. If global climate change were in fact to unfold with the serious impacts expected by many scientists, there could soon be a strong need and legal requirement to curtail greenhouse gas emissions and limit carbon-emitting land uses. Many with a direct stake in maintaining the carbon-heavy status quo emerged as loud spokespersons against the reality of climate change and the need for mitigation policies (e.g., Refs 11–13). Some of these fossil-fuel interests employed variably credentialed and often unqualified scientists, as well as purposefully created think tanks, intentionally misleading messages, channeled through the 'megaphones' of the mass media, and persistent lobbying of politicians to deliberately create an impression of inadequate scientific understanding, continuing lack of scientific consensus, and legitimate alternative explanations for the growing evidence of global climate warming.[14,15] Others were convinced about the emerging evidence and the specter of serious impacts and took on the tasks of raising public awareness, increasing understanding and engagement,

and advocating for policy change (e.g., Refs 16, 17). To the former, technical experts remained the Cassandras one should not believe, while to the latter scientists became the 'prophets' of an ominous truth. Mass media outlets—bound by a long-standing

pursuing a range of goals (education, awareness raising, behavior change), for example, in the United Kingdom, Canada, and Japan; Victoria (Australia) and California (United States); the European Union, and the United Nations Development Program. Other countries—such as the United States—have not organized central communication and outreach efforts, and instead have witnessed very active bottom-up, but largely uncoordinated and sometimes contradictory climate change communications.

Far more recent than the science on climate change is a small but rapidly growing body of scholarly work on climate change communication. Typically, contributions to that field have not grown out of the long-standing field of communication studies; rather, research on communicating climate change has emerged largely as a pressing need perceived by those directly involved in communicating the issue and by those who wish to support these communication efforts through theoretically and empirically founded insights (e.g., Refs 17, 36). A respectable body of

early signs of a changing climate have been detected in regions where most people do not live—the Arctic, at high elevations, on coral reefs and other ecosystems not visited or continuously observed by mostly urbanized populations. Moreover, these temporally and spatially distant and disconnected issues have to compete for attention with immediately felt physical needs, professional demands, economic necessities, or social obligations. Psychological research shows that direct experience and immediate demands trump vicarious experiences or abstract data almost every time (see the synthesis in Ref. 52). It is for this reason that a particularly cold winter can undermine the conviction in lay people that global warming is happening.

A third dimension of this lack of immediacy lies in the general insulation of most modern, urbanized individuals from climate and the physical environment (e.g., Refs 53–55)—living, working, learning, and playing most hours of the day in climate-controlled buildings, moving in protective vehicles through vastly human-altered landscapes, and spending relatively little time in attentive, observing, or interactive modes in nature makes it difficult to notice subtle, incremental environmental changes
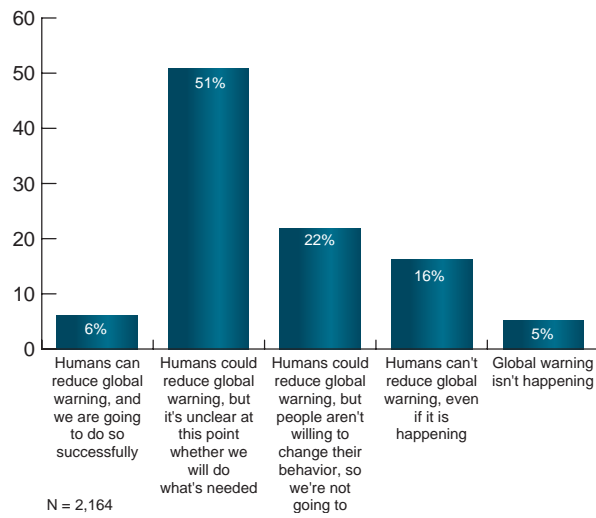
FIGURE 1 | Can and will the world reduce global warming? Survey question: Which of the following statements comes closest to your view? *Source*: Leiserowitz et al.,[28] their Figure 35, reprinted with permission by A. Leiserowitz.

though many expressed a willingness to reduce their personal energy use.

a 'backdoor,' and the common-but-differentiated fate that the interconnected inhabitants of this planet now face.

Finally, scientists have long held and will continue to hold a privileged position as knowledge holders, messengers, and interpreters of climate change. To be effective, scientists and other communicators must become more familiar with the scholarship on communication. It becomes apparent then that a communication between highly educated speakers and a lay, variably interested, and unevenly motivated audience requires substantial effort for this exchange to lead to greater understanding and constructive engagement.

The challenges of communicating climate change and their implications bring us back to Aristotle and his offering of one of the earliest theories of communication. In his *Rhetoric*, he did not restrict himself to the mechanistic exchange of information (the speech) between a messenger and a receiver. Rather, as many theoreticians of the communication process do today (e.g., Ref. 87), he illuminated some of the psychological impacts of communication and how audiences process information, the interaction between speaker and audience, the rhetorical skills and credibility of the speaker, the actual content and meaning of the information conveyed, and the role such rhetorical iue C3k201.437.1(r)-0.24rTD-0.0003 Tc[(n)-308.1(p)-2.2(lays)-31-307o.2(lays)ctualohsengers, mgeinforn

f

(

For simplicity's sake then, one may distinguish three categories of communication purposes without suggesting that they necessarily follow or build on

Purpose and audience choice are closely linked, or should be. Although communication experts

to process the message received; the goals of the communication (i.e., desired outcomes, opportunities audiences have to affect these outcomes, and the barriers they may face in taking these actions). Despite this context-dependency, some general guidelines can

of the American public examined the relationship between climate change knowledge, concern, party affiliation, and varying degrees of trust in scientists as messengers, and found that trust in the messenger is a strong mediating influence on how people interpret the knowledge conveyed to them, i.e., whether they were more or less concerned even if they had the same amount of knowledge.[172] The study also confirmed that people accept and trust messages more readily when conveyed by people with similar views (e.g., Republicans trusting Republican/conservative messengers; Democrats believing Democratic/liberal leaders; people of color finding messengers of the same racial background more credible; suburban women with children being more easily convinced by women in similar life situations; business leaders becoming persuaded by other business leaders) (e.g., Refs 128, 173, 174). The growing disparity between Republican/conservative and Democratic/liberal/ Independent views on global warming has been interpreted as at least partially influenced by the communication activism of former Democratic Vice President Al Gore.[175–177]

Trust in messengers, however, is context-dependent. Religious leaders may be trusted as climate change communicators if the issue is framed as a moral one, but not necessarily if the issue is framed as a security, scientific or energy issue.[178] The argument to focus climate communication on key opinion leaders, who in turn influence even broader audiences only underscores the importance of trusted messengers

responsive to the changing needs of audiences, close monitoring, testing, evaluating and updating of communication efforts will be required over time.

Over the course of the time in which climate change has been publicly communicated, tremendous changes have occurred in the mass media. The explosive emergence of the internet as an increasingly common channel for information dissemination, virtual dialogue, and social mobilization is maybe the most visible and important. Inseparable from that is the invention of new communication spaces such as the blogosphere. Possibilities of interaction have expanded rapidly, at the same time that there is some concern over simultaneous social isolation, and

attention, that create barriers to engagement, or—by contrast—that can enable or facilitate people's ability

37. Cialdini RB. *Influence: The Psychology of Persuasion.* 2nd revised ed. New York: Quill–William Morrow; 1993.

38. Maibach E, Parrott RL, eds. *Designing Health Messages: Approaches from Communication Theory and Public Health Practice.* Thousand Oaks, CA: Sage; 1995.

39. NRC (National Research Council). 1996. *Understanding Risk: Informing*

17/monbiot-copenhagen-emission-cuts. (Accessed March 17, 2009).

66. Dickinson JL. The people paradox: self-esteem striving, immortality ideologies, and human response to climate change. *Ecology and Society* 2009, 14:34. Available from http://www.ecologyandsociety.org/vol14/iss1/art34/.

67. Brooks H 1986. The typology of surprises in technology, institutions, and development. In: Clark WC, Munn RE, eds. *Sustainable Development of the Biosphere*. Cambridge, UK: Cambridge University Press; 325–348.

68. Faber M, Manstetten R, Proops JLR. Toward an open future: ignorance, novelty, and evolution. In: Costanza R, Norton BG, Haskell BD, eds. *Ecosystem Health: New Goals for Environmental Management*. Washington, DC: Island Press; 1992b, 72–96.

69. Faber M, Manstetten R, Proops JLR. Humankind and the environment: an anatomy of surprise and ignorance. *Environmental Values* 1992a, 1:217–241.

70. Funtowicz SO, Ravetz JR. Comment: risk management as a postnormal science. *Risk Analysis* 1992, 12:95–97.

71. Lempert RJ. A new decision sciences for complex systems. *Proc Natl Acad Sci* 2002, 99(suppl. 3):7309–7313.

72. Shackley S, Young P, Parkinson S, Wynne B. Uncertainty, complexity and concepts of good science in climate change modeling: are GCMs the best tools? *Climatic Change* 1998, 38:159–205.

73. Smithson M. *Ignorance and Uncertainty: Emerging Paradigms*. New York, NY: Springer Verlag, 1988.

74. Wynne B. Uncertainty and environmental learning: reconceiving science and policy in the preventive paradigm. *Global Environ Change* 1992, 6:87–101.

75. Oppenheimer M, O'Neill BC, Webster M, Agrawala S. The limits of consensus. *Science* 2007, 317:1505–1506.

76. Brown MA. Market failures and barriers as a basis for clean energy policies. *Energy Policy* 2001, 29:1197–1207.

77. Atcheson J. The market as messenger: sending the right signals. In: Moser SC, Dilling L, eds. *Creating a Climate for Change: Communicating Climate Change and Facilitating Social Change*. Cambridge, UK: Cambridge University Press; 2007, 339–358.

78. Dilling L, Farhar B. Making it easy: establishing energy efficiency and renewable energy as routine best practice. In: Moser SC, Dilling L, eds. *Creating a Climate for Change: Communicating Climate Change and Facilitating Social Change*. Cambridge, UK: Cambridge University Press; 2006, 359–382.

79. Agyeman J, Bullard R, Evans B, eds. *Just Sustainabilities: Development in an Unequal World*. Cambridge, MA: The MIT Press; 2003.

80. Vanderheiden S. *Atmospheric Justice: A Political Theory of Climate Change*. Oxford, New York: Oxford University Press; 2008.

81. Wolf J, Brown K, Conway D. Ecological citizenship and climate change: perceptions and practice. *Environ Politics* 2009, 18:503–521.

82. Manuel-Navarrete D, Kay JJ, Dolderman D. Ecological integrity discourses: linking ecology with cultural transformation. *Human Ecology Review* 2004, 11:215–229.

83. Sarewitz D. How science makes environmental controversies worse. *Environmental Science and Policy* 2004, 7:385–403.

84. Schultz PW. Knowledge, information, and household recycling: Examining the knowledge-deficit model of behavior change. In: Dietz T, Stern PC, eds. *New Tools for Environmental Protection: Education, Information, and Voluntary Measures*. Washington, D.C.: National Academy Press; 2002, 67–82.

85. Sturgis P, Allum N. Science in society: re-evaluating the deficit model of public attitudes. *Public Understanding Sci* 2004, 13:55–74.

86. Bak H-J. Education and public attitudes toward science: implications for the ''Deficit Model'' of education and support for science and technology. *Social Science Quarterly* 2001, 82:779–795.

87. Craig RT. Communication theory as a field. *Communication Theory* 1999, 9:199–161.

88. Littlejohn SW, Foss KA. *Theories of Human Communication*. 9th ed. Belmont, CA: Thomson Wadsworth; 2008.

89. Dewey J. *Democracy and Education: An Introduction to the Philosophy of Education*. New York: The Macmillan Company; 1915.

90. Galston WA. Political knowledge, political engagement, and civic education. *Annual Review of Political Science* 2001, 4:217–234.

91. Albert Shanker Institute. 2003. *Education for Democracy*. Washington, D.C.: Albert Shanker Institute.

92. FUTERRA. *Communications Strategy on Climate Change. Recommendations to DEFRA, The Carbon Trust, DTI, The Energy Saving Trust, the Environment Agency, and the UK Climate Impacts Program*. London: FUTERRA; 2005b.

93. Podgórecki A, Alexander J, Shields R, eds. *Social Engineering: The Techniques of Change*. Montreal: McGill-Queen's Press; 1996.

94. Major AM, Atwood LE. Environmental risks in the news: issues, sources, problems, and values. *Public Understanding of Science* 2004, 13:295–308.

95. Jackson T. *Motivating Sustainable Consumption: A Review of Evidence on Consumer Behaviour and Behavioural Change*. A report to the Sustainable

Development Research Network. Guilford, UK: Centre for Environmental Strategy, University of Surrey; 2005.

reconstructive power of social norms. *Psychological Science* 2008, 18:429–434.

124. 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.

125. Olson RL. Sustainability as a social vision. *Journal of Social Issues* 1995, 51:15–35.

126. Rose C, Dade P, Gallie N, Scott J. *Climate Change Communications—Dipping A Toe Into Public Motivation.* 2005. Available at: www. campaignstrategy.org.

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

128. Agyeman J, Doppelt B, Lynn K, Hatic H. The climate-justice link: communicating risk with low-income and minority audiences. In: Moser SC, Dilling L, eds. *Creating a Climate for Change: Communicating Climate Change and Facilitating Social Change*, Cambridge,

149. Walsh B. Does global warming compromise national security? *Time Magazine* 2008, Available at http://www.time.com/time/specials/2007/article/0,28804,1730759_1731383_1731632,00.html.

150. Wardekker A, Petersen AC JOvd Sluijs. Religious positions on climate change and climate policy in the United States. In: Carvalho A, ed. *Communicating Climate Change: Discourses, Mediations and Perceptions*. Braga: Centro de Estudos de Comunicação e Sociedade, Universidade do Minho; 2008, 53–72.

151. Green MC, Strange JJ, Brock TC, eds. *Narrative Impact: Social and Cognitive Foundations*. Mahwah, NJ: Lawrence Erlbaum Associates; 2002.

152. FUTERRA. *The Rules of the Game: Evidence Base for the Climate Change Communications Strategy*. Recommendations to the Climate Change Communications Working Group (DEFRA, The Carbon Trust, DTI, The Energy Saving Trust, the Environment Agency, and the UK Climate Impacts Program). London: FUTERRA; 2005a.

153. DEFRA (Department for Environment, Food and Rural Affairs) *Tomorrow's Climate—Today's Challenge: Your Guide to Communicating Climate Change*. London, UK: DEFRA; 2006.

154. Leiserowitz A. Communicating the risks of global warming: American risk perceptions, affective images, and interpretive communities. In: Moser SC, Dilling L, eds. *Creating a Climate for Change: Communicating Climate Change and Facilitating Social Change*. Cambridge, UK: Cambridge University Press; 2007, 44–63.

155. Thøgersen J. A cognitive dissonance interpretation of consistencies and inconsistencies in environmentally responsible behavior. *J Env Psychol* 2004, 24:93–103.

156. Bostrom A, Morgan MG, Fischhoff B, Read D. What do people know about climate change? Part 1. Mental Models. *Risk Analysis* 1994, 14:959–970.

157. Lowe TD, Lorenzoni I. Danger is all around: eliciting expert perceptions for managing climate change through a mental models approach. *Global Environmental Change* 2007, 17:131–146.

158. Sterman JD, Sweeney LB. Understanding public complacency about climate change: adults' mental models of climate change violate conservation of matter. *Climatic Change* 2007, 80:213–238.

159. Sterman JD. Risk communication on climate: mental models and mass balance. *Science* 2008, 322:532–533.

160. Kaplan S, Kaplan R. Creating a larger role for environmental psychology: the reasonable person model as an integrative framework. *Journal of Environmental Psychology* 2009, 29:329–339, doi:10.1016/j.jenvp.2008.10.005.

161. Witte K. Fear control and danger control: a test of the extended parallel process model (EPPM). *Commun Monographs* 1994, 61:113–134.

162. Witte K. Fear as motivator, fear as inhibitor: using the extended parallel process model to explain fear appeal successes and failures. In: Andersen PA, Guerrero LK, eds. *Handbook of Communication and Emotion: Research, Theory, Application, and Contexts*. San Diego, CA: Academic Press; 1998, 423–451.

163. Ruiter RAC, Verplanken B, De Cremer D, Kok G. Danger and fear control in response to fear appeals: the role of need for cognition. *Basic Appl Soc Psycho* 2004, 26:13–24.

164. Moser SC. More bad news: the risk of neglecting emotional responses to climate change information. In: Moser SC, Dilling L, eds. *Creating a Climate for Change: Communicating Climate Change and Facilitating Social Change*. Cambridge, UK: Cambridge University Press; 64–80.

165. Wilson E, Sherrell D. Source effects o59545(ands52Press;)-chads52(i)-3.

Climate Change and Facilitating Social Change. Cambridge, UK: Cambridge University Press; 2007, 167–179.

175. Dunlap RE, McCright AM. A widening gap: republican and democratic views on climate change. *Environment* 2008, 50:26–35.

176. Carroll J. *Polluted Drinking Water Is Public's Top Environmental Concern: Concern about Global Warming Inching Up. The Gallup Poll* Princeton, NJ: Gallup News Service; 2007.

177. Pew Research Center for the People & the Press. 2008, *A Deeper Partisan Divide Over Global Warming.* Washington, D.C.: Pew Research Center for the People & the Press.

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

179. Moser SC. Costly knowledge—unaffordable denial: the politics of public understanding and engagement on climate change. In: Boykoff MT, ed. *The Politics of Climate Change.* Oxford: Routledge; 2009.

180. Braverman J. Testimonials versus informational persuasive messages: the moderating effect of delivery mode and personal involvement. *Communication Research* 2008, 35:666–694.

181. Chaiken S. Heuristic versus systematic information processing and the use of source versus message cues in persuasion. *Journal of Personality and Social Psychology* 1980, 39:752–766.

182. Dillard JP, Pfau M, eds. *The Persuasion Handbook: Developments in Theory and Practice.* Thousand Oaks, CA: Sage; 2002.

183. Johnson-Cartee KS, Copeland GA. *Strategic Political Communication: Rethinking Social Influence, Persuasion, and Propaganda.* Lanham, MD: Rowman & Littlefield; 2003.

184. Slater MD. Integrating application of media effects, persuasion, and behavior change theories to communication campaigns: a stages-of-change framework. *Health Communication* 1999, 11:335–354.

185. Lee E-J, Lee J, Schumann DW. The influence of communication source and mode on consumer adoption of technological innovations. *Journal of Consumer Affairs* 2002, 36:1–27.

186. Hayes R, Matusov E. Designing for dialogue in place of teacher talk and student silence. *Culture Psychology* 2005, 11:339–357.

187. Nagda BRA. Breaking barriers, crossing borders, building bridges: communication processes in intergroup dialogues. *Journal of Social Issues* 2006, 62:553–576.

188. Tan S, Brown J. The world cafe in Singapore: creating a learning culture through dialogue. *J Appl Behav Sci* 2005, 41:83–90.

189. Regan K. A role for dialogue in communication about climate change. In: Moser SC, Dilling L, eds. *Creating a Climate for Change: Communicating Climate Change and Facilitating Social Change.* Cambridge, UK: Cambridge University Press; 2007, 213–222.

190. Wheatley MJ. *Turning to One Another: Simple Conversations to Restore Hope to the Future.* Berkeley, CA: Berrett-Koehler Publishers; 2002.

191. Stevenson T. From vision into action. *Futures* 2006, 38:667–672.

192. Norton A, Leaman J. *The Day After Tomorrow: Public Opinion on Climate Change.* London: MORI Social Research Institute; 2004.

193. Lowe T, Brown K, Dessai S, de Franca Doria M, Haynes K, 6 Tc[(nes)69cl.3(nd)-38 -1i[(H TD731.5K37,)-2igic: