

TECHNICAL COMMUNICATION QUARTERLY, 18(1), 49–81  
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ISSN: 1057-2252 print / 1542-7625 online  
DOI: 10.1080/10572250802437382



# Public Communication of Climate Change Science: Engaging Citizens Through Apocalyptic Narrative Explanation

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Working from the premise that public input is essential to science policy deliberations, we analyze how two recent works of public communication about climate change (*An Inconvenient Truth* and *Climate Change Show*) draw on the rhetorical resource of apocalyptic narrative explanation to promote scientific fluency and inspire citizen engagement in the issues. By weaving together the proofs of ethos, logos, and pathos within a framework of cultural rationality, these narratives illustrate available means of persuasion for stimulating the public's informed participation in science policy discussions.

We teach in an interdisciplinary science communication graduate program that focuses on the theory and practice of science communication in public contexts. Necessarily, this includes exploring how rhetorical situations of public science communication are related—in complex, dynamic, and sometimes uneasy ways—to expert science and policy development issues. Foregrounding these relations allows us to highlight the degree to which science and politics are intertwined, not only in terms of how scientific research is communicated to and used by policy makers but also in how diverse publics learn about and contribute to science issues that have social and ethical as well as technical meaning.

Perhaps no science issue has more obvious or urgent political and ethical significance today than climate change. From a science communication perspective, public communication about climate change offers a rich and timely site for exploring theoretical as well as practical questions about public understanding of, and engagement with, science. In particular, we are motivated by recent work on

the concepts of *scientific citizenship* and *public expertise* as valuable frameworks for considering how ordinary citizens can participate meaningfully, both directly and indirectly, in science policy discussions that affect the worlds they know and care about (Elam & Bertilsson, 2002; Kinsella, 2004).

To date, most research on public communication of climate change has focused on media coverage, mainly in the form of print journalism and, to a lesser extent, government-sponsored public awareness programs often communicated through mainstream media (e.g., Carvalho, 2007; Boykoff & Boykoff, 2004; Corbett & Durfee, 2004; Zehr, 2000; Shanahan & Good, 2000; Weingart, Engels, & Pansegrau, 2000; McComas & Shanahan, 1999; Trumbo, 1996; Bell, 1994; Wilkins, 1993). A number of researchers working in the field of public understanding of science have also studied lay attitudes and knowledge about climate change, with special attention to their implications for individual behavioral change (e.g., Bord, O'Connor, & Fisher, 1997, 2000; O'Connor, Bord, & Fisher, 1999; Robert, O'Connor, Bord, & Fisher, 1998; Stamm, Clark, & Eblacas, 2000; Bostrom, Morgan, Fischhoff, & Read, 1994; Lowe et al. 2006; Bulkeley, 1997, 2000). From a broader research perspective, recent studies of environmental communication and public involvement in environmental policy provide valuable analysis of the possibilities and the limits of diverse communicative and participatory approaches to citizen engagement in environmental policy issues (e.g., Depoe, Delicath, & Elsenbeer, 2004; Fischer, 2000; Norton, 2007; Burgess, Harrison, & Filius, 1998; Waddell, 1996; Eden, 1996; Walker, 2007).

Our exploration of climate change communication in public contexts is indebted to all these areas of research, but it differs from them in ways that, we hope, allow it to contribute something new to the growing body of research in this area. First of all, our analysis focuses on two similar (though not identical) genres and contexts of public communication that have not yet received much scholarly attention: These are the award-winning 2006 documentary *An Inconvenient Truth*, directed by Davis Guggenheim and based on Al Gore's public lecture and slideshow, and *Climate Change Show*, a multimedia object theater produced in 2001 by Science North, the science center in our Northern Ontario community, and subsequently distributed internationally. Second, rather than being concerned mainly with the implications of public communication about climate change for individual behavioral change, we are more concerned with how it can help to foster meaningful public engagement in local and global conversations about science and policy questions. In the words of the designers of *Climate Change Show*, an essential purpose of increasing public understanding about climate change is to "encourage intelligent discussion of the issue" (Science North Enterprises, 2001, p. 2). Similarly, Al Gore's Climate Change Project, which trains volunteers to present a version of *An Inconvenient Truth*'s slideshow, stresses its goal to "promote dialogue about climate change as well as potential solutions" (Climate Change Project, 2008).

These goals are consonant with the growing emphasis in environmental communication research and practice on the importance—indeed the necessity—of including citizens in environmental policy discussions and developments. Much of the recent literature on public participation in environmental policy-making has focused on deliberative democracy methods for directly engaging relatively small groups of citizens in science policy issues and debates (e.g., methods such as citizen forums, focus groups, community meetings, public hearings, public advisory committees, community-based participatory research, and so on). These are the forums in which members of the public are encouraged to adopt and develop the identity of the scientific citizen. According to Mark Elam and Margareta Bertilsson (2002), scholars and practitioners in the public understanding of science—especially in Europe—are increasingly working with “a vision of the public as capable of active and mature reasoning on technological [and scientific] issues” (p. 14). By contrast with earlier conceptualizations of the public as essentially passive recipients of expert-controlled scientific literacy, this emerging vision entails “the construction of new and more active forms of ‘scientific citizenship’ in support of knowledge-based community” (p. 4). These newer, more engaged forms of scientific citizenship are integral to the project of democratizing science and society relations by broadening public participation in policy deliberations and decision-making processes (Elam & Bertilsson, 2002; see also Irwin, 2001; Burgess et al., 1998).

Although we agree that explicitly deliberative, participatory forums are essential to the climate change policy process, we also think that the kind of public communication enacted by *An Inconvenient Truth* (AIT) and *Climate Change Show* (CCS) is integral to the development of the new scientific citizenry because it forms part of the broader sociodiscursive context within which citizens’ knowledge and attitudes about climate change are shaped. By educating public audiences about climate change issues in accessible, engaging, and meaningful ways, these rhetorical works enable the development of public expertise on a topic of deep social and ethical as well as scientific significance: helping to give people the means to participate in intelligent, substantive conversation with others—whether that be family, friends, communities, environmental organizations, policy experts, or scientists—about climate change issues.

In the context of environmental science and policy discussions, William Kinsella (2004) argues that “to counter monolithic technocratic decision making, or better yet, to engage in productive collaboration with technical specialists, members of the public must have reasonable fluency in the language(s) of science” (p. 85). Kinsella calls this fluency “public expertise”: “The ideal form of public expertise is technical competency acquired and used directly by affected citizens. Such competency need not, and cannot, replace the more specialized knowledge of technical or policy professionals, but it can provide members of the public with an adequate foundation for genuine dialogue with these specialists” (p. 85; see also Tytler, Duggan, & Gott, 2001).

Developing this public expertise on science topics represents a rhetorical challenge. Keenly aware of this challenge as it concerns environmental issues, in 1992 Jimmie Killingsworth and Jacqueline Palmer called for new genres and strategies of public science communication that will help to bridge the discursive-epistemic gap between lay and expert understandings of the world, generate public insight and motivation, and lead to more “open systems of information exchange and policy development” on environmental issues: “Crossing the boundaries of discourse communities and creating such gap-filling texts demands the fitting out of new personae, the education—indeed the invention—of new kinds of authors and audiences (real and ideal), the conditioning of subject matter to multiple situations, and the adjustment of texts to broad contexts” (Killingsworth & Palmer, 1992, pp. 279–280).

In our view, *AIT* and *CCS* are significant rhetorical actions of the kind called for by Killingsworth and Palmer, actions that contribute to the development of the scientific citizenship and public expertise that is needed for nonspecialists to be able to engage effectively in genuine dialogue with technical and policy professionals on environmental matters. In this sense, we see them as illustrating one noteworthy strand within the larger, evolving web of climate change communication and public participation in environmental policy issues. Importantly, because these works communicate about climate change science in ways that appeal rhetorically to the whole person, they serve a motivational as well as educational function, helping to inspire audiences to become engaged in knowledgeable and socially meaningful conversations about the issue. Likewise, because they communicate the science of climate change within a framework of cultural rationality rather than strict technical rationality, they serve as an important starting point for members of the public to bring their own local knowledges and situated values into the larger science-policy discussion. As Frank Fischer (2000) explains, cultural rationality situates the “statistical probabilities” and “risk-benefit ratios” of technical knowledge in cultural context: “Cultural rationality . . . can be understood as the rationality of the social lifeworld. It is concerned with the impacts, intrusions, and implications of a particular event or phenomenon on the social relations that constitute that world” (pp. 132–133; see also Plough & Krinsky, 1987; Hamilton, 2003). Although both *AIT* and *CCS* certainly provide substantive technical information and expert scientific evidence to explain the phenomenon of climate change, this discourse is woven within larger cultural narratives about the social meanings of climate change.

In the analysis that follows, then, we are especially interested in looking at how these two works are rhetorically crafted to communicate specific, situated versions of climate change science within a cultural rationality framework that simultaneously educates and engages audiences. Our approach to public understanding thus goes beyond earlier deficit-transmission models of science communication in which understanding was associated with a narrow concept of scientific literacy and retention of scientific facts. For public communication about the science of cli-

mate change to be rhetorically effective, it must also engage audiences in caring about what is being explained. In other words, it is a question of engaging the whole person through complex and rich rhetorical means, weaving together ethical, logical, and emotional proofs. It is a question of telling stories about climate change that connect the science to people's everyday knowledge, lives, values, and concerns.

To illuminate one significant way in which *AIT* and *CCS* address this rhetorical challenge to foster engaged forms of public understanding, the short analysis that follows focuses on the role of *apocalyptic narrative explanation* in *AIT*'s and *CCS*'s communication of climate change science. Our conceptualization of this strategy draws on Killingsworth and Palmer's (1992) foundational work on the prevalence and significance of apocalyptic narratives in the environmental movement combined with the research of Stephen Norris et al. (Norris, Guilbert, Smith, Hakinelahi, & Phillips, 2005) on the role and value of narrative explanation in science education. We maintain that, in their overall structures and effects, both *AIT* and *CCS* enact—albeit in quite different ways—an apocalyptic narrative explanation of climate change science. However, rather than trying to trace this trajectory across the whole of each work, we will attempt to illustrate its rhetorical forms and functions in some detail by looking closely at two central episodes from each work that, we think, enact on a small scale the larger framework.

Beyond developing a rhetorical critique of the communicative strategies that these two works employ, our analysis is ultimately concerned with considering how their narratives of climate change science contribute to the sociodiscursive construction of public expertise and the identity of the scientific citizen in relation to meaningful public engagement in climate change science and policy making. Although we see *AIT* and *CCS* as making valuable indirect contributions to this process, we also perceive limitations to the communicative, epistemic, and political assumptions that seem to inform their rhetorical purposes and effects.

In the remainder of this article, we begin by summarizing the overall story lines and communicative genres of *AIT* and *CCS*, and we describe the rhetorical situations of their creation and presentation, with particular attention to the differing climate change policy contexts in the United States and Canada that motivated each and to which each responds. We then analyze an episode from each to illustrate the complex, dynamic role of apocalyptic narrative explanation in creating rhetorically potent public communication about climate change science. Although we begin from the premise that both *AIT* and *CCS* employ the same general narrative strategy, our analysis of the narrator's ethos, the logical structuring of the claims and evidence, and the emotional appeals in each episode highlights the differences as much as the similarities in their specific methods of communication. Lastly, we reflect on the implications of this brief illustrative analysis for larger questions concerning the development of public expertise and scientific citizen-

ship as the basis for meaningful public participation in climate change science and policy-making.

### RHETORICAL SITUATIONS AND SYNOPSES OF AN INCONVENIENT TRUTH AND CLIMATE CHANGE SHOW

Both *An Inconvenient Truth* and *Climate Change Show* emerge out of and address the international context of growing concern about climate change, as supported by scientific research, and increasing efforts to avert catastrophic consequences through, in part, multinational policy agreements such as the Kyoto Accord. Within this general context, they share the basic objective of explaining the science of climate change in rhetorically effective ways in order to foster public understanding of and engagement with the issue. However, the specific political circumstances surrounding their creation contain important differences.

The policy framework for international climate change negotiations began to develop in 1988 when the International Panel on Climate Change (IPCC) was established by the World Meteorological Organization and the United Nations Environment Program. The IPCC called for a Framework Convention on Climate Change to be negotiated. This framework was prepared for the Rio Earth Summit in 1992. Al Gore, who had already written and lectured publicly about his belief in the threat of climate change, attended the Rio Summit. He subsequently published *Earth in the Balance* (1992) and, one month after Rio, became Bill Clinton's vice-presidential running mate. In 1997, while vice president, Gore was part of the U.S. delegation to Kyoto that signed the protocol. However, the U.S. Senate voted 95–0 that the United States not ratify the Kyoto Accord because developing nations were not required to make greenhouse gas reductions and because, it was claimed, participation would hurt the U.S. economy. Since then, and even more so under the Bush administration (which withdrew the United States completely from the Kyoto process), opposition to ratifying the Kyoto Protocol has been fed by a public campaign to undermine the growing IPCC consensus on the scientific evidence of climate change by emphasizing the science as ostensibly uncertain and thus an unacceptable foundation for public policy.

In this context of U.S. official political opposition to developing climate change policy in accord with the IPCC framework, *AIT* functions as an important grassroots form of environmental “counter-expertise” (Fischer, 2000) by working to persuade public audiences that the science of climate change is solid and should be used as the basis for public policy. *AIT* thus participates in what Peter Healey et al. (2005) identify as an “agonistic” context of science governance, characterized by conditions of adversity and opposition to government policy decisions in which a variety of stakeholders, including citizen groups, struggle for authority and influence (p. 18).

Produced several years before *AIT*, *CCS* by contrast can be seen as emerging more out of an educational context of science governance. In this type of context, according to Healy et al., “conflicts or tensions regarding science and technology policy are [seen to be] founded on a lack of knowledge on the part of the public. Hence it is necessary to educate the public through dissemination of scientific (expert) knowledge in order to create an informed public of scientific citizens that understand the experts’ assessment of the problems and possibilities of science” (p. 18). Certainly this context aligns with the general institutional mandate of science centers to engage visitors in informal learning experiences on science topics. It also, however, aligns with the larger Canadian political context at the time of *CCS*’s creation. Unlike the U.S. government, the Canadian Liberal government, led by Prime Minister Jean Chrétien, supported the Kyoto initiative prior to ratifying the Protocol in 2004. Concomitantly, the federal government established a Climate Change Action Fund intended to support projects financially in four areas: foundation analysis; technology early action measures; science, impacts, and adaptation; and public education and outreach (Environment Canada, 1997).

The creation of *CCS* was made possible by funding from the Climate Change Action Fund. Thus, the public science communication objectives of *CCS* support—rather than oppose—those of the Canadian government of the time. In this context, although public audiences may be perceived as lacking knowledge or awareness of the issue, they are not expected to be potentially hostile to accepting the science of climate change.

These differences in the rhetorical-political situations for *CCS* and *AIT* help to explain key differences in their overall emphases and tone: Whereas *AIT* adopts a generally serious and at times earnestly moralizing tone to communicate the message that, contrary to the U.S. government’s official position, climate change is a scientifically proven phenomenon, *CCS* by contrast focuses less on making the case that climate change exists and more on defining what the phenomenon of climate change is. Consonant with the presumption of an unresisting audience as well as the science center’s institutional mandate to make science learning fun, the tone of *CCS* is less stern and foreboding than that of *AIT*, incorporating ingredients of comedy and gently ironic humor along with its serious (but not heavy-handed) explanations of climate change science. Thus, although both *AIT* and *CCS* attempt to explain global warming and inspire their audiences to join the movement for change, each emphasizes a different aspect of the argument: *CCS*, in the context of a science center, concentrates more on explaining the role of the atmosphere in sustaining life and how human activity is changing the atmosphere with potentially dire consequences. *AIT* also provides explanation but dedicates proportionally more time to establishing that climate is changing, that there are consequences and that humanity—Americans in particular—must take responsibility and act. The distinction is clear from the opening sequences of each presentation where both view the earth from the moon. The point made in *CCS* is that the earth, unlike the cold airless moon, has an atmosphere to sustain life; *AIT* uses the view

from space to emphasize that the earth and its atmosphere are finite, not an inexhaustible resource impervious to the effects of human activity.

As a feature-length documentary film, *AIT* weaves together the story of Al Gore's public slideshow lecture about climate change with the story of his personal journey to becoming an environmental activist. Although this personal story constitutes a significant dimension of the film and its rhetorical impact, because of our primary interest in the narrative explanation of climate change science we are focusing specifically on the slideshow story. The tone of this narrative is set initially by the views from space of the finite earth and several scenes of disaster—including shots of Hurricane Katrina. The greenhouse model is presented in an animated diagram and immediately the effect of increased concentration of CO<sub>2</sub> is demonstrated. A denier's explanation, in the form of a short Matt Groening cartoon, is then introduced as an object of ridicule.

The science narrative from this point on concerns the efforts of scientists to gather the data and establish the connections, beginning with the story of Gore's teacher, George Revelle, who first studied the concentrations of CO<sub>2</sub> in the air. After showing the effects of warming on mountain glaciers, Gore describes the effort to establish the connection between CO<sub>2</sub> and temperature. This is the section of the film that we analyze in detail. Following this, the slideshow documents numerous effects of warming all over the globe, concentrating on the poles, ocean currents, growing seasons, disease, storms, and flooding. To establish human deforestation, population growth, energy production, and waste disposal, Gore argues that continued use of the same technologies will have "dire consequences," but changing habits and technology can produce a different result, one which need not entail economic hardship. In his concluding patriotic call to action, he compares the struggle to mitigate climate change to honorable battles of the past against fascism and racism that engaged the American public.

*Climate Change Show* is a 20-minute mixed-media presentation called an *object theater* that takes place in a small theater, capacity approximately 25, with seating arranged in a U-shape around a small open stage floor area that is dimly lit during the show. As shown in Figure 1, primary communication is via video on a large main screen on the back wall; at the center of the theater, a synchronized secondary globe screen shows the earth's atmosphere, climate patterns and other supplementary footage (Figure 2).

Distributed around the stage area and hanging from the ceiling are real everyday objects such as a car engine, a wind turbine, an electric can opener, a small pile of coal and a stuffed sheep, that are spotlit at appropriate times during the show (Figure 3).

The theater is fitted with a sophisticated sound system and other technological support that engulf the audience in tactile atmospheric effects such as rain and wind. As an object theater, *CCS* includes no live human actors; instead, its story of climate change is narrated by an animated talking sheep, projected onto the center of the back screen (Figure 4).



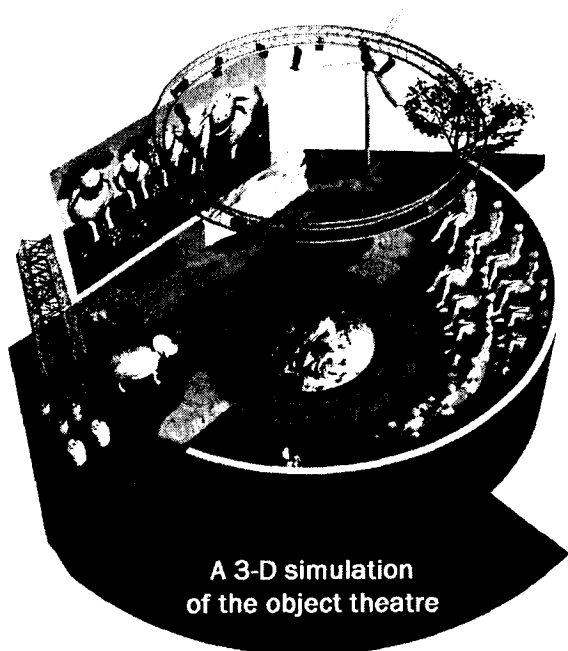


FIGURE 1 A 3-D simulation of the object theater.

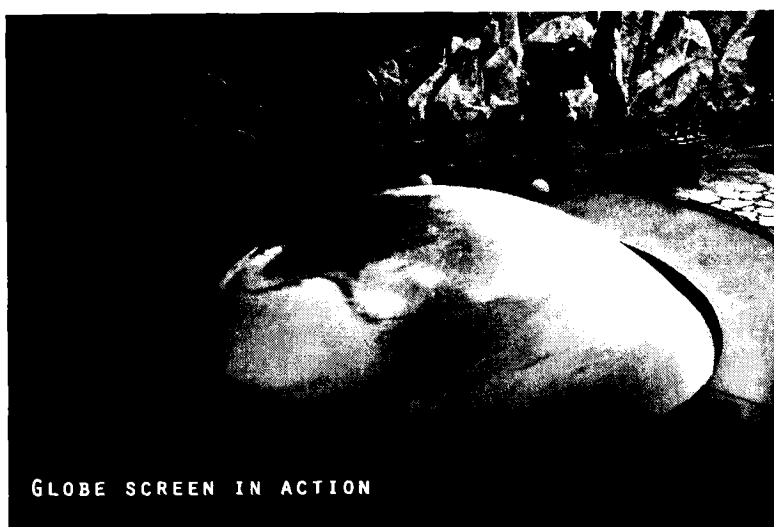
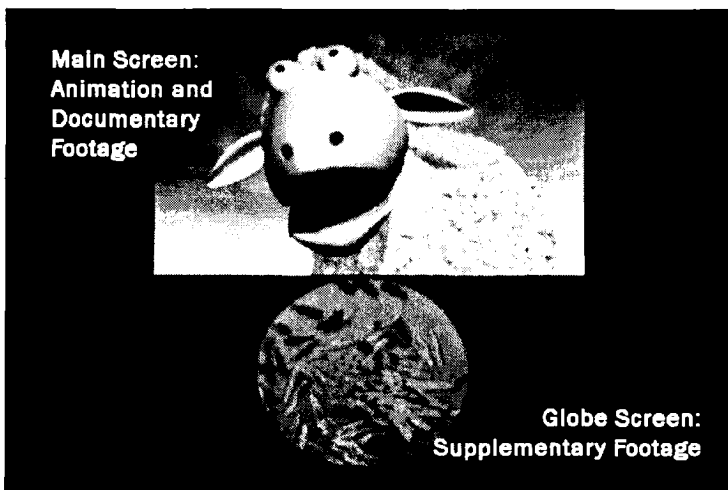


FIGURE 2 Globe screen in action.



**FIGURE 3** Objects in the theater: the sheep and the electric can opener.



**FIGURE 4** Main screen: animation and documentary footage. Globe screen: supplementary footage.

From the starting claim that the atmosphere sustains life, *CCS* explains the role of early life-forms in using  $\text{CO}_2$  from the atmosphere and simultaneously giving off oxygen. With the dead organic matter stored in sediments and then rocks of Earth's crust, the carbon cycle was established, dynamically controlling the concentration of  $\text{CO}_2$  in the atmosphere. The role of  $\text{CO}_2$  in keeping the planet at a steady, warm temperature is explained using the greenhouse metaphor, and the distinction between climate and weather is made to explain why there are different conditions for life all over the planet. With the scientific model in place, the stage is set for understanding anthropogenic effects, starting with a lifestyle of convenience. Convenience requires energy, which comes mainly from burning fossil fuels, which releases buried carbon dioxide back into the atmosphere, which increases the greenhouse effect, which increases the temperature. Is it true? In the three scenes we analyze in detail, after presenting evidence of increasing temperature and predictions of further warming to come, *CCS* describes the current and future consequences on the planet and on living things before calling on the audience to act to mitigate climate change. This conclusion emphasizes both personal initiatives and responses on a societal scale such as the adoption of alternate energy sources.

### APOCALYPTIC NARRATIVE EXPLANATION: CONCEPT EXPLANATION

We have proposed the concept of *apocalyptic narrative explanation* as a fruitful framework for understanding the rhetorical forms and effects of communication about climate change science in *AIT* and *CCS*, both at the macro level of each work's story line as well as the micro level of the two episodes we have selected for more detailed analysis.

According to Killingsworth and Palmer (1996), apocalyptic narratives in the environmental movement have appeared at historical moments when the movement is seeking to expand its base of support and engage new publics. They argue that "millennial rhetoric bears a dialectical relation to public support for the environmental movement" (p. 22). Its primary aim is "to transform the consciousness that a problem exists into acceptance of action toward a solution by prefacing the solution with a future scenario of what could happen if action is not taken, if the problem goes untreated" (p. 22). By recounting past and present evidence for climate change and the future scenarios that can be predicted based on this evidence, and by using these predictions to persuade audiences for the need to take action to avoid these scenarios, both *An Inconvenient Truth* and *Climate Change Show* enact basic features of the apocalyptic narrative structure though, in the latter case, the style and tone are not alarmist.

Our claim is that, in the context of each work's explanation of climate change science, this basic apocalyptic framework combines with the communicative strategy of *narrative explanation* that Norris et al. (2005) have identified as an important—but not widely recognized or practiced—mode of science education. As a number of professional communication scholars have demonstrated, narrative plays a central role in multiple types of science communication, ranging from stories about the human actors and institutions involved in scientific enterprises, to the narrative structure of scientific reports and the narrative logic of equation, to narrative explanations of scientific discoveries in both expert and public contexts, to the narrative invention of scientific knowledge (e.g., Johnson-Sheehan & Rode, 1999; Myers, 1990, 1994; Bazerman, 1997; Barton & Barton, 1998; Bryson, 2003).

Not only communication scholars but also complex systems scientists argue that, in order to understand the natural world, science must embrace narrative as a valid scientific method. Per Bak (1996) explains in *How Nature Works* that the behavior of any nonlinear, self-organizing critical structure (such as a sand pile, a brain network, or an ecological system) can be understood only in terms of dynamic interrelations, and such complexity cannot be reduced to a sheer cause-effect chain. In such cases, only the epistemological perspective of narrative or story can describe the emergent property of the scientific subject. For Bak, narrative is not just a communication device; like a chemical formula or a mathematical equation, it is a way to describe nature, and, perhaps more importantly, a method of modeling to predict the future based on existing knowledge.

In their research on the role of narrative in science education, Norris et al. (2005) distinguish between narrative explanations intrinsic to the discipline of science and those that are extrinsic. In their words, "An explanation intrinsic to science is one that explains some natural phenomenon [in Bak's sense] and is part of the body of scientific knowledge. An explanation extrinsic to science is one that explains something about science, and is thus outside the body of scientific knowledge itself" (p. 537). Our analysis of *AIT* and *CCS* posits that both extrinsic and intrinsic forms of narrative explanation inform their communication about climate change science. The interaction of these two modes is, we suggest, integral to their construction of climate change science from the perspective of cultural rationality rather than a strict technical rationality. Importantly, the inclusion of intrinsic narrative explanation ensures that the cultural perspective on climate change science incorporates (rather than avoids or opposes) technical-scientific knowledge. In this way, *AIT*'s and *CCS*'s explanations of climate change science simultaneously promote technical fluency and stimulate public engagement.

But how exactly do they do this? From a rhetorical perspective, we think that the communicative power of the apocalyptic narrative explanations in our selected episodes stems to a significant degree from how they integrate the traditional persuasive appeals of ethos, logos, and pathos in ways appropriate to their rhetorical

situations. In the following brief, illustrative analysis, we will consider how these appeals are combined in each work by exploring the ethos of each work's narrator or science storyteller (i.e., Al Gore in *AIT* and the talking sheep in *CCS*); the logical structuring of the science narrative, including the kinds of claims and evidence that are presented; and, perhaps most significantly, the role of emotion and affect in fostering an engaged public understanding of climate change science.

## RHETORICAL ANALYSIS OF SELECTED EPISODES

The episode that we have selected for analysis from *AIT* occurs approximately 20 minutes into the film, namely chapters 8 and 9 in the DVD version. The ice, Gore says at the beginning of chapter 8, has stories to tell. He explains how drilling ice cores yields histories of both CO<sub>2</sub> concentration and temperature over time, in mountain glaciers and in Antarctica. By graphing them together, he demonstrates the argument that CO<sub>2</sub> is the most important determinant of temperature; with the rising concentration of CO<sub>2</sub>, present and future, he foretells the global warming to come.

Our selected episode from *CCS* consists of scenes 5, 6, and 7 of the show's total nine-scene sequence. The previous scenes have established that human activity is increasing atmospheric CO<sub>2</sub>, which suggests that the climate should be warming. Is it? In this episode, the sheep explains that, in spite of the variations associated with weather, it is possible to determine from temperature records and ice core drilling that the climate is indeed warming. According to climate modelers, warming will continue and the secondary effects such as ice melt and evaporation will impact the living conditions of humanity in many different and severe ways.

### Ethos of Narrators

In both *AIT* and *CCS*, the ethos of the narrators—the characters who recount the story of climate change science for their public audiences—contributes in important ways to the rhetorical effectiveness of each narrative. Both employ a similar technique of having nonscientists explain the science of climate change, though the ethos of these characters differs in significant ways appropriate to their different rhetorical contexts.

For viewers of *AIT*, the ethos that the film constructs for Al Gore as public communicator of climate change science is necessarily colored (at least for U.S. audiences) by his situational ethos as a well-known figure in partisan politics combined with his lesser-known identity as a published author and speaker on environmental issues. For viewers who already share Gore's environmental values if not his knowledge, this situational ethos can be assumed for the most part to enhance rather than detract from the persuasiveness of his narrator-character in the film,

though his identity as a partisan politician may introduce elements of skepticism about his motives, particularly to the extent that the film is seen as a veiled platform for political self-promotion. In this context, how the film constructs Gore's intrinsic ethos (i.e., the character that he communicates within the film itself) is integral to how effectively the film communicates about climate change science.

Although he had been doing his climate change lectures for some time before the film was made, he did not yet enjoy a broad reputation as an environmentalist. The film's backstory of Gore's personal journey thus helps to establish his credibility by portraying him as experienced, committed, reflective, and socially concerned: He is driven and self-sacrificing in his quest to alert America and the world but he is certainly not opportunistic. Essentially, Gore's character in this part of the film models the behavior of knowledgeable, engaged, and concerned citizen that he is trying to inspire in his audience for the public lecture.

Supported by this background characterization, Gore's on-stage ethos combines the classical traits of good sense, good morals, and goodwill: He appears authoritatively knowledgeable about his subject, he emphasizes (both in words and tone) the ethical implications of this subject, and he shows his concern for his audience both in communicating about his subject accessibly and by pointing out its significance to them and the worlds they inhabit. Strategically, he negotiates the agonistic context of his environmental message by maintaining for the most part a serious but moderate conversational style of delivery, with only occasional, carefully timed expressions of pronounced passion for his subject or of ridicule for his opposition (for example, when he utters the phrase "deeply unethical" after describing the apocalyptic scenario and American responsibility for it or when he impersonates the views of the "so-called skeptics" concerning the evidence for climate change). In this way, he bolsters his credibility—and the credibility of the scientific evidence for climate change—as being eminently reasonable and trustworthy. Most notably, his ethos as a science communicator combines the persona of ordinary citizen and of well-connected advocate: On one hand, he employs rhetorical techniques that foreground his shared identity with his lay, public audience; on the other, he works to bolster his credibility as an authoritative source of knowledge by stressing his personal friendships with experts in climate change science and his firsthand observation of their scientific investigations.

In our selected episode, this ethos of the outsider-insider science communicator who functions as a mediating bridge between lay and expert knowledge is clearly communicated. From his opening claim that "the ice has stories to tell us," [our emphasis], Gore positions himself as simultaneously a kind of naive observer of the wonders of science and an intimate, privileged associate (if not full member) of the scientific community conducting this research: Thus, for example, it is thanks to "my friend Lonnie Thompson" that Gore was invited to witness firsthand research on the Antarctic ice core, an experience that now allows him to share with his audience what he observed. In this way, he implies that the audience can trust

his scientific knowledge because he has seen the evidence with his own eyes: He is trustworthy because he has firsthand observation, and the science is trustworthy because it has been observed by him.

Gore's privileged access to the inner circles of scientific research is likewise communicated through his apparently offhand comment, as he explains the graph that visually correlates CO<sub>2</sub> and temperature increases in the Antarctic, that "this incidentally is the first time that anybody outside of a small group of scientists has seen this image." If Gore is special because he has access to the latest insider knowledge, then his audience is special too because he is sharing it with them. Like his framing of the ice core evidence, he again invites his audience to understand and accept the scientific evidence of the CO<sub>2</sub>-temperature correlation by framing it within the commonplace (but not necessarily scientific) epistemic criterion that seeing-is-believing: "Now if you look," he says, "you can see . . . how closely they [the red and blue lines representing CO<sub>2</sub> and temperature] fit together."

In effect, Gore adopts the role of science teacher, a pedagogue who, in the tradition of Quintilian, is concerned with his students' moral as well as intellectual development. This character is reinforced by director Davis Guggenheim's use of techniques commonly used for filming TV evangelists: dynamic changes of camera angle that position Gore in the foreground against his presentation materials and audience in the background (Figure 5), low angle shots that establish a sense of authority (Figure 6), and warm color temperature that engages the senses. In this teacherly-preacherly role, Gore provides explicit direction to his audience about how to interpret the material he presents and what to consider most significant. And he also, perhaps somewhat patronizingly, withholds "complicated" scientific explanation that he considers unnecessary or maybe beyond the audience's capac-

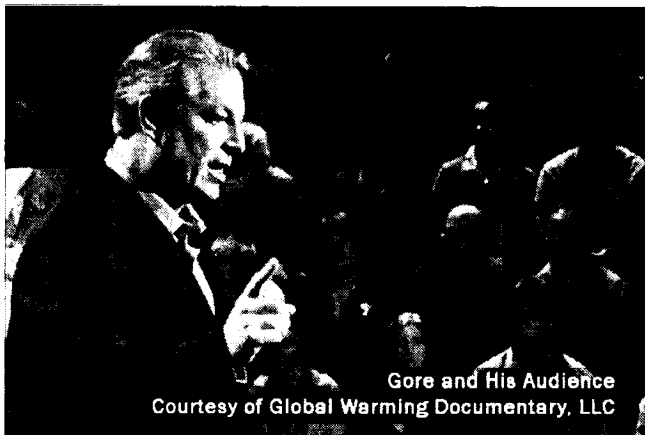


FIGURE 5 Gore and his audience. Courtesy of Global Warming Documentary, LLC.

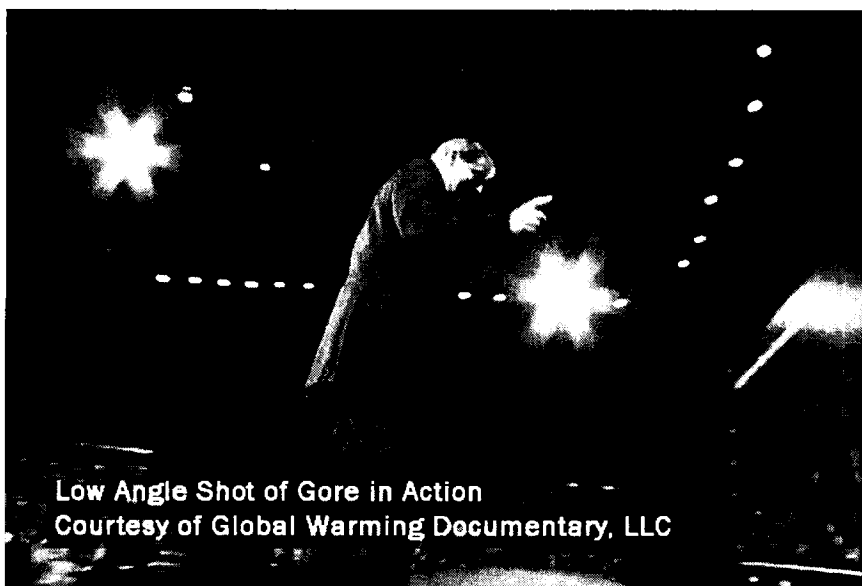


FIGURE 6 Low shot of Gore in action. Courtesy of Global Warming Documentary, LLC.

ity for understanding the meaning of climate change (though presumably it is not beyond his own capacity). This ethos emerges quite clearly during his explanation of the significance of the Antarctic graph, when he states that “the relationship [between  $\text{CO}_2$  and temperature] is actually very complicated, but there is *one* relationship that is far more powerful than all the others and it is this: When there is more carbon dioxide the temperature goes up.” At this crucial point in the explanation of the correlation of  $\text{CO}_2$  concentration to temperature, Gore reaches the presumed boundary of public understanding of the science. If the audience is to accept this explanation, it is on the authority of Gore the narrator, not directly that of scientific expertise. As the mediator between expert science and lay knowledge, Gore explicitly assumes the role of determining what the public does, and does not, need to know about climate change science.

In *Climate Change Show*, the narrator is a cartoon sheep with the voice of popular Canadian television satirist, Rick Mercer. As an invented, original cartoon character, this talking sheep obviously does not possess a preexisting, situated ethos, though it is likely that some audience members (at least in the context of *CCS*’s Canadian showings) would recognize the voice of Rick Mercer. Such a recognition would, in all probability, increase the sense of slightly ironic humor that infuses the show.

By comparison with the strong but largely conventional ethos that Al Gore enacts in *AIT*, the ethos of *CCS*’s narrator appeals precisely because of its unconven-



tional and humorous qualities. For the informal learning context of a science center, such a choice of narrator contributes to the mandate of making science fun as well as educational. It also potentially helps to predispose the audience to listen openly to the show's explanation of science change because of the unexpected, disarming effect of being addressed by a talking sheep. As Alan Nursall, one of the show's designers, explains, "The sheep was . . . driven by our discussions to give this show a voice that was completely unexpected, non-threatening, non-preachy, non-hypocritical, unconventional, emotionally accessible. If you're going to have a Voice of God host for climate change, then Al Gore is fine (in fact, pretty good), but it is *really* easy to do it badly" (A. Nursall, personal communication, 2008).

Ironically, although the imaginary, nonhuman character of the talking sheep would, on the surface, seem to be considerably more dissociated from the audience than Gore from his audience, how this sheep explains the science of climate change actually fosters a greater degree of identification with the lay public. Primarily, this is because the sheep does not claim any special insider connections or superior understanding. Instead, he characterizes himself more modestly and approachably as a self-confessed "woolly brained" sheep, even though he does of course communicate knowledgeably about climate change science. This self-characterization allows him to admit an ignorance of some sophisticated scientific ideas that many in the audience undoubtedly share but then to use these admissions as openings to explain the science in accurate yet accessible, simplified ways.

In scene 5, for instance, the sheep introduces the explanation of global warming by asking a question that models, through everyday language, the kind of question an attentive member of the audience might have by this point in the show: "So, the question is, Since carbon dioxide is a greenhouse gas, and there's more of it in the air, will the atmosphere trap more heat? Put more simply, Is our planet heating up?" Comically, the sheep turns to his fellow cartoon sheep to try to find the answer ("I'll just ask around . . . Hey you guys! Have you noticed the earth getting warmer lately?"), thus modeling how ordinary citizens might try (inappropriately) to arrive at an answer through anecdotal rather than scientific evidence. This rhetorical strategy, according to Nursall, was very deliberate: "There are several scenes that are very purposefully inserted to make sure the audience is hearing themselves, or at least hearing conversations that everyone has had. The scene with the sheep musing about past climate is one example, and that helps us set up the need for proper scientific analysis. You can't understand climate change by looking out the window, or from a climatic history sample size of one" (A. Nursall, personal communication, 2008). Importantly, the implied critique of a common layperson's approach to understanding climate change is softened by having the sheep enact this mode too, as a necessary step to realizing its limitations ("Okay, you're no help at all. No, really, thanks, guys."). By encouraging the audience to laugh at the sheep's initial approach to answering the question of whether the planet is "getting warmer lately," this segment allows them in turn to laugh, indi-

rectly and nonthreateningly, at themselves. At the same time, though, the modeling of an inappropriate lay approach followed by an explanation of an appropriate scientific approach to the question seems to reinforce rather than diminish the separation of lay knowledges and experiences from the practices of scientific knowledge-making.

Like Al Gore, the sheep—as public science communicator—both presumes and bolsters the authority of scientific expertise for understanding climate change. However, unlike Gore, the sheep does not try to enhance his own ethos by claiming any special connection with the scientific community or firsthand observation of scientific research. Instead, he adopts an informed outsider perspective to explain, in substantive but accessible and at times entertaining ways, what scientific experts know and do; in other words, not only what climate change scientists have discovered but also (and perhaps more importantly) how climate change science works. Such an approach accords with Tytler et al.'s (2001) finding that procedural knowledge of science as well as basic knowledge of fundamental concepts are essential ingredients of science education that supports effective public participation in environmental discussions (p. 361). In scenes 5 and 6, for example, the sheep introduces the audience to the two main types of climate change scientists (represented by cartoon pictures hanging from the ceiling). These are “climatologist, Type A—the adventure seeker. He spends his life traveling the world, diving the oceans, scaling glaciers, looking for places where the earth has left traces of its past climate” and “climatologist Type B—the computer modeller. The modeller wants to figure out what will happen to the earth's climate in the future . . . As far as my woolly brain can tell, the modeller basically builds a living earth inside the computer in order to see how it will change.” These scientists are generic types, not personal friends; the sheep's ethos is bolstered not because he knows the right people in the right places but because, to the extent that his ostensibly “woolly brain” permits, he understands and can explain in simple but engaging lay terms what climate change scientists do and how the field as a whole generates knowledge.

### Narrative Logic

Even though in these two episodes neither Al Gore nor, especially, the talking sheep narrate their explanations of climate change in what one might call an apocalyptic doom and gloom tone, their accounts of the scientific claims and evidence for climate change develop an essentially apocalyptic trajectory. In both *AIT* and *CCS*, the episodes we are analyzing communicate the part of the story when the description of past and present evidence is wrapped up and dire future scenarios are projected.

The narrative of our selected episode from *AIT* begins with a causal argument for global warming, framed in terms of ice core evidence. First, photographs and video sequences tell the extrinsic story of ice core research as an observable, tangi-

ble human activity while Gore describes the science involved in gathering evidence from air trapped in layers of annual snowfall. In his description, Gore says the concentration of  $\text{CO}_2$  can be measured as can the temperature via isotopes of oxygen. Although he does not explain this obscure process, he presents it as a delight he is sharing with fellow amateurs.

This initial commonplace mode of visual representation (i.e., photography and video) and Gore's concurrent explanation lay the groundwork for the audience to understand the subsequent more specialized scientific representation, in graphs, of  $\text{CO}_2$  and temperature data and the correlation between them. He presents 1,000 years of data from mountain glaciers then 650,000 years from Antarctica. The first story stops at the present day but the second is extended with projections to construct a complete apocalyptic narrative.

Before demonstrating the correlation of  $\text{CO}_2$  concentration to temperature in the mountain glacier data, Gore takes a brief detour, showing only the temperature data so he can debunk claims that current warming has precedents in the past, specifically a medieval warming period. The graph (Figure 7) is a somewhat unusual representation in which annual temperatures are portrayed as adjacent bars of variation from a baseline (despite its erroneous labeling that has been corrected in the book, Gore, 2006). The baseline temperature is the conventional value, the average temperature over the period 1961–1990 (Gore, 2006), so most years are below the line or cold. The use of bars rather than points fills in the space and emphasizes the predominance of cold years. The display corroborates Gore's claim that earlier warming periods did occur but were trivial in comparison to temperatures of the last century. With this point made, Gore returns to more conventional line graphs with the temperature data smoothed to highlight the comparison with  $\text{CO}_2$  concentration. The graphs are shown side by side, and he claims we can see how closely they fit together.

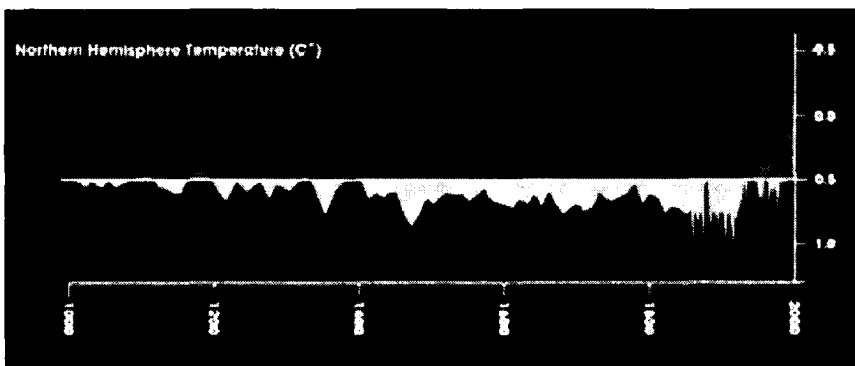


FIGURE 7 Bar graph of northern hemisphere temperatures.

When he moves to the Antarctic data, Gore faces a dilemma. The temperature variation over the longer period is much greater; on that scale, recent temperature increase looks insignificant whereas CO<sub>2</sub> is demonstrably far more concentrated than at any time in 650,000 years. How to avoid the impression that there is no correlation and no problem? As we show below, he foregoes the opportunity to present a more sophisticated explanation and appears to avoid the problematic data.

The intrinsic narrative of climate change science that this episode develops centers on the two parallel chronological sequences of data from 650,000 years ago up to the present, but the temporal order in which Gore narrates this science explanation differs from the past-to-present chronology. Narratives, according to Norris et al. (2005), recount “events structured in time” (p. 542). Implicitly invoking the narratological distinction between *fabula* and *sujet* (Barton & Barton, 1988; Lay, 1982), they note how the temporal structure of the events recounted occurs in two dimensions: (a) the chronological time sequence of the plot events recounted, and (b) the sequence in which the narrator chooses to order the events of the story. Just so, instead of following the past-to-present chronological sequence of the data (the “plot events” of this science story), Gore starts his presentation of the narrative in “the present day era,” not now but far enough in the past to avoid recent anthropogenic effects. He reveals the CO<sub>2</sub> concentrations in reverse order, travelling backward through time, right to left across the stage, identifying ice ages as he goes. Then he moves forward again, displaying temperatures over the same period from left to right. Using the two similar graphs, he reiterates the similarity between the CO<sub>2</sub> concentration and temperature. This is when he states that the relationship between temperature and CO<sub>2</sub> is “very complicated.” Unlike the previous scene of the oxygen isotopes, he now distances himself from the audience by implying that he, like the scientists, understands this relationship but that it is too complicated for the audience. In effect, he asks the audience to accept on his authority that the greenhouse effect is the “*one* relationship that is far more powerful than all the others” [Gore’s emphasis].

Finally, he compares the temperatures—and matching CO<sub>2</sub> concentrations—in and out of the last ice age and notes the secondary environmental effect: “This is the difference between a nice day and having a mile of ice over your head.” In these ways, Gore retells the story told by the scientific data from the perspective of the public’s understanding and engagement in it, situating it in relation to their sociohistorical location and explaining it by analogy with familiar phenomena.

Now begins the apocalyptic projection, made all the more powerful by the fact it begins in the past—humanity already inhabits the doomsday scenario. The unfolding red line on the graph reveals the remaining CO<sub>2</sub> data forward to the present. The line rises swiftly, in stark contrast to the rest of the graph. The temperature line, which would be almost flat if it were projected, is not extended. (In the book, the temperature data line appears to be the same shape but stretched horizontally to reach the current time, corresponding to the elevated CO<sub>2</sub> concentration. This is

confirmed in the text (Gore, 2006, p. 67). Next, the graph of CO<sub>2</sub> concentration is extended 50 years into the future. The line rises even more steeply. Again Gore limits the extent of the scientific explanation by avoiding the question of uncertainty: Only one projected concentration is shown. Properly labeled though it is on the graph, this value is only one of many possible predictions. To complete the logic of this most apocalyptic scenario, Gore invites the audience to infer, by analogy, the effect of such an increased concentration of CO<sub>2</sub>: "If this much on the cold side is a mile of ice over our heads, what would that much on the warmer side be?" He has finessed the missing temperatures and, through enthymematic reasoning, asked the audience to fill in the future ones for themselves.

Having constructed the long causal chain from "unrestricted fossil fuel burning" to CO<sub>2</sub> concentration to temperature rise to implied dire consequences, Gore concludes this central episode with an explicit appeal to avoid the apocalyptic outcome in cultural, not scientific, terms: "Ultimately, this is really not a political issue so much as a moral issue. If we allow this to happen, it is deeply unethical."

By contrast with the *AIT* episode, the *CCS* episode we analyze is concerned only with establishing that atmospheric temperature is indeed rising and what the consequences might be. The relationship between human activity and CO<sub>2</sub> concentration has already been established earlier in the show.

Scene 5 establishes that a warming trend already exists. While it sets up scene 6 where warming is predicted to continue into the future, this section also addresses the tricky methodological problem of establishing climate trends obscured by weather fluctuations. Like *AIT*, *CCS* draws on the logic and graphical representation of scientific data to explain that the planet is heating up but the presentation is framed in the thrice-repeated pattern of a classic fairy tale such as "Goldilocks" or "The Three Little Pigs." In the first segment, as discussed in the ethos section above, the sheep asks others in his flock if there has been a change in the temperature; he rejects their responses because they recount anecdotal and seemingly contradictory observations based on too short a timeframe to be scientifically meaningful.

The second segment examines longer-term temperature records—regular quantitative records that "we" have been keeping, says the sheep—as the graph is projected. The rise in recent years is dramatic and apparently significant. The 1990s are the warmest decade in 150 years, he observes, and allows that the trend worries "people." But he again challenges the evidence. Even 150 years is not long enough to be certain the rising temperature is anomalous.

The third segment introduces the expert authority of Climatologist Type A, who travels the world in search of traces of past climate, "laid down in layers" in growth rings, mud, or ice. The climatologist's discoveries create a graph of 1,000 years showing that recent temperatures are abnormal. The tentative conclusion that "we" have made from temperature records is confirmed by the expert. This time there is no rebuttal. Although the scene explicitly demonstrates that uncertainty in science

tific claims is never totally removed, the narrative structure leaves no doubt that the atmosphere is warming.

Scene 6 projects the warming trend to continue. The challenge of this scene is twofold. The explanation of the science is more complex (prediction by modeling rather than interpretation of layering), and the data are simulated and apparently inconclusive because—unlike *AIT*—alternative scenarios are suggested. However, the form of the narrative is familiar: Another climatologist, a computer modeler represented through another spotlit cartoon portrait, predicts more warming to come. The verbal explanation is supported through the dramatic effect of lighting up a large, older-style computer monitor hanging from the ceiling, its screen replaced by a globe. Concurrently, an animation of simulated temperature predictions plays out across the curved surface of the global sphere emerging from the stage floor. The actual global climate model is cited only as “some very clever science” that is beyond the “woolly brain” of the narrator who places his trust, and therefore the audience’s too, in the authority of the modeler and the computer. The uncertainty of predicting temperature is broached in a simple way. With a graph of colored lines all curving up, some more and some less, the sheep foretells a range of possible temperature increases, ascribed to the “very tricky science” of modeling.

In scene 7, we see the current and future effects of the warming. Although the tone of this section is not as strongly apocalyptic as the dramatic projection and prophetic tone that conclude the *AIT* episode, nonetheless the evidence and claims of this scene paint a frightening picture of what the world can expect if it continues on its current course. There is more reliance on video footage than on abstract graphics, on real people than on cartoon figures. In our assessment, the rhetorical effectiveness of the story of the consequences of climate change for a public, science center audience derives from its integration of scientific claims with other forms of evidence.

The scene begins by stating a very basic scientific fact: “when ice heats up, it melts.” However, to prove this claim and to demonstrate its effects, the narrator turns to nonscientific sources: “For the past 50 years,” he tells the audience, “submarine pilots have been noticing the arctic ice sheet melt by 40 percent.” And who better to explain the effects of this melting ice than the people who live there? Through a brief interview with Inuit community leader Rosemary Kuptana, projected on the main screen, the audience hears how the melting ice is “changing our way of life” in negative ways. Logically, this segment leads to the next: Melting ice causes sea levels to rise. Once again, the effect of this on real people in real places is communicated, this time through the personal testimony of the premier of Tuvalu, a small South Pacific nation that is only a couple of meters above sea level. Whereas scene 5 suggested a hierarchical separation between scientific and nonscientific ways of knowing, scene 7 uses the situated, anecdotal evidence of nonscientists as proof for its scientific claims about the consequences of global warming.

## Pathos

In the apocalyptic narrative of climate change, it is the doomsday scenario to be avoided that carries the most emotional impact, by simultaneously engendering fear that the scenario may occur and, in response to this fear, hope that it can be avoided and a sense of commitment to take the steps necessary to avoid it. In our view, the pathos at work within our selected episodes from *AIT* and *CCS* is integral to how the audience understands their narrative explanations of climate change science. That is, instead of seeing pathos as somehow opposed to rational understanding, we see it as a mode of communication that can generate significant insights and meaning, a powerful form of knowledge-making in its own right. In this regard, it is central to—not merely supportive of—the development of public understanding or expertise about climate change science that *AIT* and *CCS* attempt to foster. It is a key dimension in creating engaged forms of public understanding that exceed the narrow bounds of technical rationality.

How then do these two episodes depict the dire consequences of global warming so as to deepen the audience's understanding of the subject and, based on this insight, to engage them in the quest for avoidance?

In *An Inconvenient Truth* it is the vertical extension of the CO<sub>2</sub> graph at the end of the episode that defines the apocalyptic scenario. Although the graph itself is designed to make the abstract information that it presents as emotionally stimulating as possible (for example, through its size, its use of color, and through the unfolding movement of the rising CO<sub>2</sub> line), the final section heightens the emotional impact of the apocalyptic logic by employing a theatrical strategy of dramatic emphasis.

Earlier in this episode, as Gore shows the long history of Antarctic ice core, the width of the graph emphasizes the length of the historical record but the vertical displacement is human scaled—he can gesture directly at the display as he speaks. When he extends the CO<sub>2</sub> record to the present, demonstrating the switch from constrained oscillation to a rapid increase in concentration, the orientation of the scene, the visuals and the activity, switches from horizontal to vertical.

In a long shot Gore is shown looking up at the current concentration level. Where he has been interacting directly with the screen he is now dwarfed. He then introduces a theatrical gimmick, a scissor lift that he rides toward the top of the graph. He acknowledges the gimmickry and shares a laugh with the audience as he rises. The ride temporarily slows the pace of the presentation, emphasizing the increase in height and concentration. Importantly, the metaphoric quality of this rhetorical strategy (i.e., the height that Gore must rise to reach the top of the concentration line has no causal connection to the actual increase in concentration) generates a particular kind of insight about climate change science that would be difficult to achieve with only a more literal explanation. This insight enriches the

epistemic ground for the audience's knowledgeable commitment to avoiding the dire prediction. As he reaches the high point of the graph (Figure 8), Gore reminds the audience "and we have done that," a dramatic declaration of shared responsibility. In the context of such an enormous effect, this is a call for engagement, not just as individuals but as a community, a call for political action.

The extension of the graph a further 50 years into the future includes an extension of the gimmick. As the line rises, steeper still, Gore rides up beside it. At the top edge of the screen, the motion suspends briefly then continues onto a supplementary screen, drawing more laughs from the audience. Paradoxically, the humor of this scene helps to make the audience more—not less—receptive to the seriousness of the projected consequences.

Finally, the projected concentration in 2050 is plotted and labeled as the result of "unrestricted fossil fuel burning." Consonant with Gore's communication of climate change science throughout this episode (and elsewhere in the film), scientific uncertainty about precise projections is ignored. Instead, from on high (literally and figuratively), Gore authoritatively declares that the data is completely accepted by the scientific community, thus reinforcing a sense that the only way to avoid this definitive scenario is to take action now. Otherwise, the effect will be experienced by children now in the audience, he says as he appears to seek them out, a narrative strategy to make the apocalyptic future real and imminent by connecting it to the present with a meaningful story.

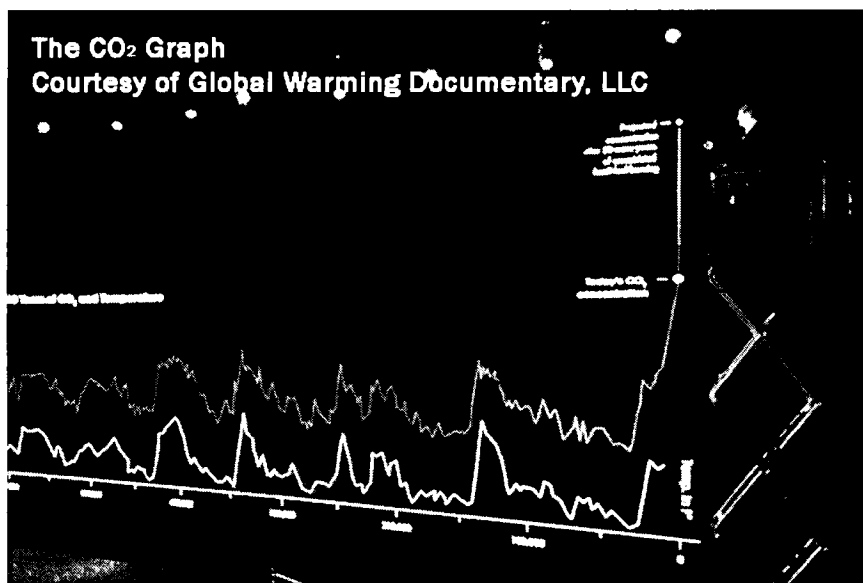


FIGURE 8 CO<sub>2</sub> graph. Courtesy of Global Warming Documentary, LLC.



Confident that he has successfully proven his case (notably, through the proofs of ethos and pathos as well as logos), Gore acknowledges the “so-called skeptics” but, within the terms of his narrative, leaves them no recourse but to claim the projected concentrations are no cause for alarm. He dismisses them without even mounting a scientific argument. He simply cranes his neck to look up at the graph (the descent of the scissor lift is edited out) and gets his supporting laugh. He then proceeds to exploit the proportional comparison he has previously set up, recalling the connection of temperature change to the retreat of the ice age and posing the question of what the effect of increased concentration of CO<sub>2</sub> will be. There is no answer, only the image of the variation of temperature compared to the much larger increase on the CO<sub>2</sub> graph. Through this visual enthymeme, he leaves the audience to create apocalyptic scenarios of their children’s future in their own minds.

In *Climate Change Show*, the depiction of the apocalyptic consequences of global warming is also rendered through dramatic techniques that help to increase the audience’s understanding of climate change as well as their commitment to avoiding the dire consequences that climatologists predict. The tone, however, is less morally charged than in *AIT*: Unlike Gore, the sheep does not directly appeal to the audience’s sense of guilt (e.g., “we have done that”) as motivation to become involved in the issue. This difference in the degree to which moral suasion informs each work’s narrative makes sense given the different rhetorical situations that each addresses: Gore, in the agonistic U.S. context of the “so-called skeptics” pursues a mission to create public acceptance that the science is right (both factually and morally, as it were); the talking sheep, in the educational context of a Canadian science center whose mandate for public education on climate change is supported, not opposed, by the state, has less need for exhortative rhetoric.

Nonetheless, the epistemic power of the predicted consequences of climate change in scene 8 derives from rich forms of pathos, theatrically rendered. As we have already noted, the final scene describing the effect and consequences of global warming has a faster pace and illustrates rather than explains the secondary environmental changes and adverse living conditions. The visual elements are no longer graphs and climate models but live action videos as the rate and intensity of experience builds. The pacing and intensity create a sense that climate change is already happening quickly, thus fuelling a sense of urgency to avoid its direst consequences.

To dramatize the consequences, the narrative is taken over twice by real people (not cartoons), representatives of affected groups: Inuit spokesperson Rosemary Kuptana and the premier of Tuvalu. Hearing and seeing these real people speak about how global warming will be, indeed already is, affecting their communities creates a personalized, human connection for the audience, bringing home the meaning of climate change by inviting them to understand the problem from the perspective of these fellow human beings. Simultaneously, the flashing images of

extreme weather events dramatize what could be in store for these communities and, by extension, the rest of the world—including the audience. Building on the fast-paced aural and visual stimulus that this scene enacts, in its final moments it achieves an even more complete sensational effect: As the sheep speaks about how the storm intensity will increase around the world, the soundtrack of storms becomes louder and the audience is sprayed by mist and blown on by ventilating fans to simulate the rain and wind of stormy weather. Here, the double meaning of feeling as both emotion and sensation is dramatically achieved, engulfing the audience in a memorable embodied process of understanding the meaning of climate change.

## DISCUSSION

According to Patrick Sturgis and Nick Allum (2004), a key reason for public communication of science is the assumption that

[a] scientifically literate citizenry is . . . one that can effectively participate in public debates about science and hold government to account over the speed and direction of science policy. From this normative perspective, in modern democratic societies, citizens need to have sufficient levels of accurate information on which to base their assessments of policy alternatives in order that their policy preferences best reflect their own self or group interests. (p. 55)

To the extent that *An Inconvenient Truth* and *Climate Change Show* communicate accurate (though necessarily selective) information about climate change science, they play a noteworthy (though necessarily limited) role within the larger, multifaceted context of public communication that can help citizens to participate effectively in policy discussions on the issue. From a rhetorical perspective, these works clearly illustrate that developing sufficient levels of accurate information need not consist simply of a dry, unengaging transmission of scientific facts and data simplified for public consumption; it can be (and perhaps needs to be) a rich and dynamic communicative process, a process that integrates the proofs of ethos, logos, and pathos in meaningful and memorable ways. Specifically, our analysis has identified the framework of apocalyptic narrative explanation as a key resource deployed by these works to communicate climate change science in terms of a cultural rationality that includes, but goes beyond, technical rationality.

Nonetheless, at its core, each presentation must operate in the scientific domain and face the challenge that confronts the creator of every artifact of science communication: how to distill, summarize, and analogize the scientific story so the nonexpert understands and appreciates what the scientist has found after a lifetime of concentrated effort. Over the unavoidable gaps in what can be explained there

must be a bridge and that bridge is faith in the scientist or surrogate, the narrator. On the credibility of these bridges of trust rests the entire narrative. We have analyzed the boundaries of explanation in *AIT* and *CCS*, how at critical points, the narrator claims or calls in expertise unavailable to the audience. Al Gore positions himself variously as fellow amateur, as interlocutor, and ultimately as expert in the sense that he understands the overall picture of climate change and the apocalyptic consequences it entails. He may not have all the scientific expertise, but in the broader domain, he is the cultural rationalist. In *CCS*, the sheep's constructed ethos is not all that different. He depends on the climatologists for the science, but he is the voice of authority in the apocalyptic descriptions. Perhaps the apocalyptic narrative is successful because the story of disaster is evident and compelling in ways that exceed the technical rationality of the scientific core.

Even though *AIT* and *CCS* do not directly engage citizens in science policy discourse in the way that, for example, citizen forums or public advisory committees can, nonetheless we claim that they indirectly facilitate the new and more active forms of scientific citizenship described by Elam and Bertilsson (2002). Interestingly, however, the kinds of scientific citizenship rhetorically implied and constructed by *AIT* and *CCS* differ in their emphases. These differences can be attributed, at least in part, to differences in their rhetorical contexts and purposes. *CCS* was developed early in the millennium when climate change was a less urgent public concern and the Canadian government had taken a position supporting the mitigation of global warming. Hence *CCS*, aimed at a science-friendly audience of early adopters, is focused on enabling a foundational understanding of climate change science for its own sake, rather than in the explicit service of political engagement. Notably, this includes an understanding of how the science works, not just what the science tells us. Such an approach was situationally possible because the show was created within a context of alignment with rather than opposition to dominant governmental views of climate change science. It thus implicitly supports a political orientation without explicitly calling the audience to active citizenry duty. What actions it does call for are, for the most part, at a personal level. In this sense, *CCS* could be said to foreground the scientific dimension of scientific citizenship, despite its reliance on a range of seemingly nonscientific, playful, and dramatic techniques to create an entertaining and memorable experience for the audience.

Paradoxically, though the public lecture strand of *AIT* uses a very scientific-style presentational mode delivered by Gore in his role as accessible but serious science teacher, ultimately the film's main message concerns the ethical-political dimensions of climate change. Its science education serves the larger purpose of motivating citizens to participate in the political process of holding government accountable. In this sense, we see *AIT* as emphasizing mainly the citizenship part of scientific citizenship. This emphasis is completely consonant with the context of its production. Five years after *CCS*, public awareness of global warming was

growing and an opportunity existed to enlist enough support to tip the balance of public opinion in favor of remedial action, a position in opposition to American government policy.

Despite the differences in their specific political contexts and motivations, from a broader ideological perspective we see *AIT* and *CCS* as sharing similar mainstream assumptions concerning the role of individual citizens, the authority of scientific expertise, and faith in the capacity of science and the political and economic system to mitigate climate change if support for the necessary research and action can be rallied. For *CCS*, such an ideological framework is no surprise, given its science-center institutional context and government-funded status. For *AIT*, such a claim may be less obvious, given its opposition to official U.S. policy and its role in stimulating climate change activism in the United States and internationally. But for all that *AIT* may contest existing government policy, it certainly does not call into question the American political system as a whole or fundamental values of progress and patriotism. In this sense, both *CCS* and *AIT* participate in a mainstream environmental discourse, a discourse that presumes the apocalypse of global warming can be avoided within existing political, economic, and scientific systems. Whether such presumptions are right or wrong is not our point; instead, noticing this dimension of the two works enlarges our understanding of their rhetorical motivations and functions, particularly in relation to more radical, structurally critical modes and motives of environmental discourse that foreground the tensions between dominant political-economic systems (e.g., global capitalism) and progressive environmental change (see Cox, 2004; Opel, 2007; Tevelow, 2004).

Our claim that *AIT* and *CCS* are, in different ways, rhetorically effective in configuring the apocalyptic narrative to develop public expertise about climate change science and foster scientific citizenship is not, of course, unqualified. Certainly, as we have noted in our preceding analysis, the narrative that each recounts is selectively crafted to communicate a particular version of climate change science. Each version can thus be critiqued for what it excludes or perhaps oversimplifies. Recognizing the limitations as well as the strengths of each work's communicative action helps to determine what other kinds of public communication about climate change may be called for in specific sociopolitical contexts in order to ensure that diverse publics can participate meaningfully in science policy discussions.

Most obviously, because *AIT* and *CCS* are essentially presentational modes of discourse (though very stimulating, engaging presentational modes), the audience is positioned essentially in the role of spectator (albeit spectators who are encouraged by the presentations to become intellectually, emotionally, and ethically engaged in the subject). The viewing experience does not, on its own, offer the rhetorical means for members of the public to directly or immediately participate in "intelligent conversation" (Science North Enterprises, 2001, p. 2) or "dialogue" (Climate Change Project, 2008) about climate change science though it does, po-

tentially, provide the stimulus and background to pursue these activities subsequently. Without denying the value of presentational modes of science communication, we note that the spectator position risks reinscribing a deficit model of public understanding of science, a model in which experts possess knowledge that is transmitted, in simplified form, to a public who lacks this knowledge.

Although both *AIT* and *CCS* integrate nonexpert ways of knowing and communicating about the world into their scientific narratives, they nonetheless in essence tell the audience what to think about climate change. They do not, within the boundaries of their presentational modes, facilitate the integration of the audience's lay knowledges and concerns about the subject. In the case of *AIT*, this weakness has to some extent been addressed by the development of a surrounding network of communicative forums and activities (many of them online) that offer concerned citizens more concretely participatory ways of becoming involved in the global conversation and political activism about climate change. In the case of *CCS*, an interactive exhibit about climate change located adjacent to the object theater invites audiences to frame the science in relation to their individual lifestyles, but the kind of lay knowledge called for here consists simply of personal data input. Now, 5 years on, in a context where the Canadian government is widely seen to be bungling the climate change file, it is perhaps time to create, as a follow-up to each screening of *CCS*, an open discussion forum. This forum could, like the *AIT* forums, enhance the show's effectiveness not only in teaching the public about climate change but in leading citizens, young and old, to coconstruct their own evolving knowledges and forms of scientific citizenship with more emphasis now on the citizenship component.

## CONCLUSION

As teachers of science communication, we have sought in this paper to identify and investigate the role that communication with the public plays in the process of developing policy around matters of science and technology. Successful policy is undeniably dependent on public input, debate, and support. To participate in this scientific citizenship, people need both to understand and be engaged with the science. Such an engaged understanding involves more than the kind of basic scientific literacy that was the objective of earlier approaches to public communication of science. In the case of climate change, as we have attempted to show, public engagement in the science means appealing to the whole person through all three modes of rhetorical proof: The logos of the scientific narrative must be integrated with a trustworthy ethos to scaffold the understanding, and the technical details must be reinterpreted within a framework of cultural rationality that engenders a sense of social significance and personal caring. For *An Inconvenient Truth* and *Climate Change Show*—as for many other instances of environmental and climate

change communication—the apocalyptic narrative structure functions as a powerful rhetorical resource for integrating these modes of proof into politically and ethically as well as technically compelling science stories.

In terms of climate change policy, the kind of public expertise and scientific citizenship fostered by these sorts of narratives can and should contribute to more than public awareness aimed at promoting individual behavioral change and uncritical acceptance of official policies. As the scientific apocalyptic predictions for climate change continue to grow, now more than ever citizens need to use their political power, science knowledge, and cultural rationality to participate actively in the policy development process. In this context, science communicators likewise have a crucial role to play in meeting the rhetorical challenge of communicating climate change science in ways that facilitate the public's situationally meaningful engagement in this process.

### ACKNOWLEDGMENTS

Thanks to Richard Wildeman of Science North for creating the 3-D image of the object theater, to Chantal Barriault and Alan Nursall for their insights on the design and reception of *Climate Change Show*, and to our anonymous reviewers for their perceptive and constructive suggestions.

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