Challenges of Advocacy for Sustainability Scientists

by

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ABSTRACT

Without scientific expertise, society may make catastrophically poor choices when faced with problems such as climate change. However, scientists who engage society with normative questions face tension between advocacy and the social norms of science that call for objectivity and neutrality. Policy established in 2011 by the Intergovernmental Panel on Climate Change (IPCC) required their communication to be objective and neutral and this research comprised a qualitative analysis of IPCC reports to consider how much of their communication is strictly factual (Objective), and value-free (Neutral), and to consider how their communication had changed from 1990 to 2013. Further research comprised a qualitative analysis of structured interviews with scientists and non-scientists who were professionally engaged in climate science communication, to consider practitioner views on advocacy. The literature and the structured interviews revealed a conflicting range of definitions for advocacy versus objectivity and neutrality. The practitioners that were interviewed struggled to separate objective and neutral science from attempts to persuade, and the IPCC reports contained a substantial amount of communication that was not strictly factual and value-free. This research found that science communication often blurred the distinction between facts and values, imbuing the subjective with the authority and credibility of science, and thereby damaging the foundation for scientific credibility. This research proposes a strict definition for factual and value-free as a means to separate science from advocacy, to better protect the credibility of science, and better prepare scientists to negotiate contentious science-based policy issues. The normative dimension of sustainability will likely entangle scientists in advocacy or the appearance of it, and this research may be generalizable to sustainability.

DEDICATION

To Rhonda, my partner, my friend.

ACKNOWLEDGMENTS

In the summer of 2011 I met with Dr. Sander van der Leeuw with a brief Powerpoint presentation and my argument that the scientific community needed an improved communication model. This conclusion was the result of two semesters of graduate classes at the School of Sustainability at Arizona State University, informed by my two decade career in sales and marketing in the Consumer Packaged Goods industry. My question to Dr. van der Leeuw that day pertained to the possibility of my pursuing a doctoral degree on sustainability communication to which he was supportive. Dr. van der Leeuw was not only instrumental in my acceptance to the School of Sustainability but he has steadfastly and patiently supported my efforts and clearly none of this would be possible without his generous mentorship. I must also acknowledge Dr. Nalini Chhetri who agreed to shoulder a lion's share of dissertation committee work. Dr Chhetri's support ranged beyond mentoring and she recommended and supported my attendance to several conferences pertinent to my research subject. Climate change is a rich subject for the study of sustainability communication and I must recognize the contribution of Dr. Sonja Klinsky whose expertise includes the Intergovernmental Panel on Climate Change (IPCC) and her guidance was crucial to my analysis of IPCC communication. I would also like to recognize Dr. Mark Hannah for his contribution in the areas of rhetoric and persuasion. I am deeply indebted to each of these dissertation committee members for their insight, hard work, and patience in contributing to an unusual, yet interdisciplinary treatment of sustainability communication.

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IMORTANT TERMS

1. I use the Oxford Dictionary's definition of *advocacy*: "public support for or recommendation of a particular cause or policy" (OED, 2013).
2. The term *scientist advocacy* will be used in this dissertation to refer to advocacy by scientists. While there is no scholarly consensus on the precise definition, scientist advocacy is generally considered to occur when scientists urge a course of action or express public support for or recommendation of a particular cause or policy (AAAS, 2012).
3. I use the Oxford Dictionary's definition of *communication:* "the successful conveying or sharing of ideas and feelings" (OED, 2013).
4. I use the word *mitigation* in the context of climate change, which refers to human intervention to reduce the sources or enhance the sinks of greenhouse gases (IPCC, 2014)
5. For this dissertation, the use of the terms *science* or *sustainability science* will refer to a body of knowledge, a group of people or their organizations, or the process of scientific discovery (Gauchat, 2012).

CHAPTER 1

When I had the privilege in 2007 of accepting the Nobel Peace prize on behalf of the IPCC, in my speech on the occasion I asked the rhetorical question "Will those responsible for decisions in the field of climate change at the global level listen to the voice of science and knowledge, which is now loud and clear?" I am not sure our voice is louder today, but it is certainly clearer on the basis of new knowledge. I hope the world at large and this august audience would shape their actions on the basis of scientific evidence on all aspects of climate change and projections of the future, a future that we are all responsible for. (Pachauri, 2012)

Rajendra Pachauri, Chairman - Intergovernmental Panel on Climate Change (IPCC), November 2012.

Problem Statement

As visualized by scholars, sustainability science[1] involves an explicit normative role for scientists: to solve sustainability problems and influence societies to develop a more sustainable trajectory. But the communication, advocacy, and persuasive demands of this role are poorly conceived and its challenges underestimated. Focusing on solutions extends scientific activity beyond describing past or present states to include prescribing action to achieve some normative future state. In other words, to not just persuade the academy about how things are or have been but to also persuade society about how things

[1] For this dissertation, the use of the terms *science* or *sustainability science* will refer to a body of knowledge, a group of people or their organizations, or the process of scientific discovery (Gauchat, 2012).

ought to be. To the "is" of normal science[2], sustainability adds the "ought" of sustainability science. Scientists have long been capable of argument within the norms of persuasion involved in the peer review process but have not developed effective persuasive capabilities to support the new normative role in which they may be prescribing costly action in the present to generate some future or unseen benefit for society. In an exemplary problem like climate change, a more than two decades long effort to persuade global societies to reduce their carbon dioxide emissions five percent below 1990 levels has failed, and global emissions have instead risen by more than fifty percent since 1990 (EPA, 2014). Based on these results, sustainability science needs an improved communication strategy to operationalize the normative role envisioned for sustainability scientists.

As with Pachauri above, scientists often reveal the expectation that their scientific credibility and authority should be sufficient to convince societies to accept their policy recommendations. But this has not been an effective strategy for influencing decision-making in contentious sustainability problems relating to climate change. In assuming the role of problem solver, sustainability scholars have presumed that scientists possess the requisite influence to guide policy decisions, but they have both underestimated the challenge and overestimated scientist's capabilities. In taking the mantle of problem solver, sustainability scientists enter a realm where, unlike the peer review process, there are no rules, and no referee, and science is but one input in a complex and fickle decision-making process. While scientists have been successful historically in advocating

[2] The term *normal science* refers to scientists describing past or present states within existing theoretical frameworks which only change gradually with the addition of new knowledge (Kuhn, 1962). Normal science is largely descriptive and not prescriptive.

for environmental policy, it has largely been out of the sight of the public and non-controversial. But with sustainability problems like climate change, the solutions that scientists have advocated would be socially disruptive and costly, and their prescriptions have become controversial and met with public and political resistance sufficient to stymie scientist's policy recommendations, particularly in the U.S. Indeed, many governments have put off climate policy action, arguing that it would be too costly.

Without the influence of science, society may make catastrophically poor decisions, and to improve scientists' influence on important science-based but contentious policy issues, sustainability scientists need improved communication skills, to both understand and appropriately respond to the values and world views of other stakeholders, and to influence decision making. Improved understanding of other stakeholders is required to develop plausible policy recommendations, and improved persuasion is required to more effectively influence the decision-making process.

Background

Scientists often feel a moral obligation to not only warn society of dangers they discover through their research but to also advocate for change that would reduce or eliminate the danger (AAAS, 2012; Steneck, 2012). Environmental scientists have for decades demonstrated a personal interest in the outcomes of their science by openly advocating for more protective environmental policy, such as discontinuing the use of DDT. But with the growth of the environmental movement, scientist advocacy[3] has

[3] The term *scientist advocacy* will be used in this dissertation to refer to advocacy by scientists. While there is no scholarly consensus on the definition, scientist advocacy is generally considered to occur when scientists urge a course of action or express public support for or recommend a particular cause or policy (AAAS, 2012).

become increasingly controversial and met with social resistance from industry and the political right (Steneck, 2012). Scientists who advocate for solutions to social-ecological problems may face economic, social, and political resistance from entities that are threatened by their recommendations. As in the case of climate change, scientists' advocacy may produce mixed results or outright failure.

Scientists commonly persuade by leveraging their scientific credibility, (their ability to inspire trust in their work), and their scientific authority (their expertise). However, scientist advocacy conflicts with science's internal behavioral norms thought to govern scientists' behavior and preserve that scientific credibility and authority (Nelson, 2009). Some scholars continue to argue that science must be neutral (value-free), objective (solely fact-based), and disinterested (scientists must not have a personal interest in the outcomes of their science). It is thought that these qualities help ensure that scientists do not possess a partisan agenda and that they remain trusted sources of credible information. Scientists have propagated and jealously guarded this reputation and as a result, society largely believes that scientists adhere to these norms (Jasanoff, 1987; Mulkay, 1976).

Science has never been truly objective or neutral because scientists are subjective human beings whose personal values and biases influence their choice of research, their methodologies, their questions, observations and measurements, and their interpretations of their research results (Kaiser, 2000). However, this inherent subjectivity is ancillary and distinct from the explicit normative intent in sustainability, in which scientists intend to solve problems and do commonly develop an interest in the outcome of the problems they study. Ethical questions about whether or not scientists should advocate have resulted in some controversy within society as well as the academy, creating a significant and unmet challenge to the normative dimension of sustainability.

Although in controversies like climate change the stakes for society may be high, some scholars, including climate scientists, continue to argue that scientists should avoid advocacy (Edwards, 2013; Jasanoff, 1987; Merton, 1973; Mulkay, 1976; Sarewitz, 2011). Indeed, the Intergovernmental Panel on Climate Change (IPCC) has formally embraced objectivity and neutrality in communication, in an explicit effort to preserve their credibility. Although sustainability scholars posit a normative role for scientists, the academic question remains whether scientists should advocate for the solutions they develop, and that is a dilemma which these scholars have not satisfactorily addressed. Many climate scientists develop ideas for solutions to the problem, and in response some scientists such as James Hansen become active advocates while others such as Tamsin Edwards argue that scientists should never advocate. Between those extremes resides a great deal of confusion, misunderstanding, and controversy. Many sustainability scientists who are intent on solving problems are thrust into this milieu largely unprepared for the communication challenges involved in striving to implement their solutions, and many are in denial that this work may entail advocacy or the appearance of advocacy.

Confounding the problem is the fact that the scientific community has not precisely defined scientist advocacy, and debates about when it occurs and under which conditions (Nelson, 2009). Many scientists believe they avoid advocacy with objectively structured language such as: “If the goal is to avoid climate change, then greenhouse gas emissions must be reduced.” These scientists hold that such a statement is not advocacy

(J.M. Scott & Rachlow, 2011). Other scholars insist that advocacy may be an unavoidable condition of the political milieu rather than an artifact of individual scientists' behavior. For example: the otherwise academic question of the presence or absence of an earthquake fault may become controversial if the location is later considered for siting a nuclear plant. In this case, an objective scientific opinion about the existence of the fault is no longer possible and any scientific opinion tendered will be aligned with or against the siting of the nuclear plant, and tantamount to advocacy for one side or the other (Sarewitz, 2012). Using this argument in the case of climate change then, any alignment to the primary global mitigation policy is tantamount to advocacy for that policy.

In 2011, the American Association for the Advancement of Science (AAAS) convened a conference on scientist advocacy and, although not formally conclusive, observed that advocacy may be nearly unavoidable, and that scientists are increasingly pressured to engage in advocacy (AAAS, 2012). In sustainability, scholars have explicitly called for a normative role for scientists to influence how social-ecological systems should evolve (R. W. Kates et al., 2001; Reid, 2010; Wiek, Withycombe, & Redman, 2011). But scholars have gained no consensus as to how scientists should realize this role. I argue that advocacy is an unavoidable complication of the normative intent in sustainability, and that new research is needed to understand the challenges of scientist advocacy better so that scientists, who choose to, can advocate more effectively.

Research Context

Climate change is a prime exemplar of a sustainability problem and involves more than twenty years of active scientist advocacy. Greenhouse gas (GHG) emissions from human activities are largely responsible for the observed global warming[4] over the past century, and will lead to dangerous climate change. Societies urgently need to take action to substantially reduce their GHG emissions in order to mitigate the threat to human civilization. This statement represents the fundamental consensus of the vast majority of climate scientists and many scientific societies, scientific academies, the U.S. Government, and intergovernmental bodies like the IPCC (NASA, 2014). IPCC scientists predict that climate change will have undesirable impacts such as sea-level rise, biodiversity loss, increased drought, increased storm intensity, floods, disease, and crop failure, all of which threaten Earth's life-support systems, and that substantial and sustained reductions of GHG emissions will be necessary to mitigate the risks (IPCC, 2007, 2013b).

From the earliest indication that climate change might be dangerous, climate scientists have worked to persuade society about the risks and of the need for action to manage those risks, but the distinction between risk assessment and risk management is easily blurred (Jasanoff, 1999). Climate scientists' credibility and authority regarding the risks of climate change may be damaged when they advocate for action to manage those risks. But many climate scientists insist that the science is clear and directly implies the solution, suggesting that the scientific facts about the problem can answer the subjective policy questions involved in solving it. Climate scientists have largely failed to convince societies to take action to mitigate climate change, which some scientists view as a rejection of the science. However more Americans accept the facts of global warming

[4] Global warming leads to climate change and, while technically distinct, the terms are largely interchangeable in common scientific and public use (Schuldt, 2011).

than support enacting climate policy (PEW, 2014). The scientific community has largely failed to contemplate the essential feedback that society has rejected scientists' policy ideas but not necessarily the science.

Since climate change is linked to GHG emissions, it is a simple logical connection that emissions should be cut and this is the scientific basis for climate change mitigation and the impetus behind the scientific community imploring society to take action to reduce GHG emissions. However, societies do not yet share climate scientists' sense of urgency, and global emissions of GHG have risen despite scientists' advocacy to reduce them (IPCC, 2013b). Advocates of emissions reduction blame the rise partly on the United States (U.S.), which has resisted global treaties to reduce GHG emissions. The U.S. is a leading emitter of GHG and must reduce its emissions as a part of any mathematically feasible plan to reduce global GHG emissions. While the scientific consensus that human activity contributes to climate change has strengthened with each new IPCC Assessment Report (AR) (Christ, 2008), concern among Americans about climate change has lagged, and Americans have ranked global warming low among priorities for their President and Congress (PEW, 2013, 2014). Furthermore, many U.S. politicians avoid pursuing climate policy because their constituents do not see the urgency of the problem and are more concerned about other social challenges. While concern about climate change has been lowest mostly among political conservatives (PEW, 2013), this group has proven sufficiently influential to stymie climate policy proposals. Neither Mitt Romney nor Barack Obama campaigned on climate change in the 2012 presidential elections, nor did any of the four moderators in the presidential debates mention the issue (Broder, 2012). Essentially, the consensus risk assessment of the climate science community has not conveyed to the public or to policy makers at a rate necessary to facilitate the policy development that scientists recommend. Many in the scientific community perceive this to be a deficiency with the public understanding of climate science and believe that increasing the quantity and quality of scientific information will remedy the problem and convince society to follow their advice.

By 2014 the IPCC had released its fifth AR, which stated in the strongest terms yet the panel's consensus about climate change and the need for reducing GHG emissions:

> Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions (IPCC, 2013b, p. 19).

Segments of modernized economies, which are invested in and dependent on fossil energy, have perceived the call for emissions reduction as a threat, and have opposed climate scientists' prescription for GHG emissions reductions. Since climate scientists have consistently invoked the scientific credibility of their research as the foundation for their authority to advocate for policy change, their opponents have just as consistently attacked the credibility of the science as a means to resist the scientific authority to prescribe that change. Numerous groups opposing the scientific consensus persistently attack the credibility of climate science, claiming, for example, that actual global temperatures have failed to rise according to IPCC predictions (see Figure 1) and that the science, and therefore the science-based recommendations, are wrong. A cursory internet search produced many arguments similar to the chart below, which attacked the science as a means to oppose prescriptions based on climate science.

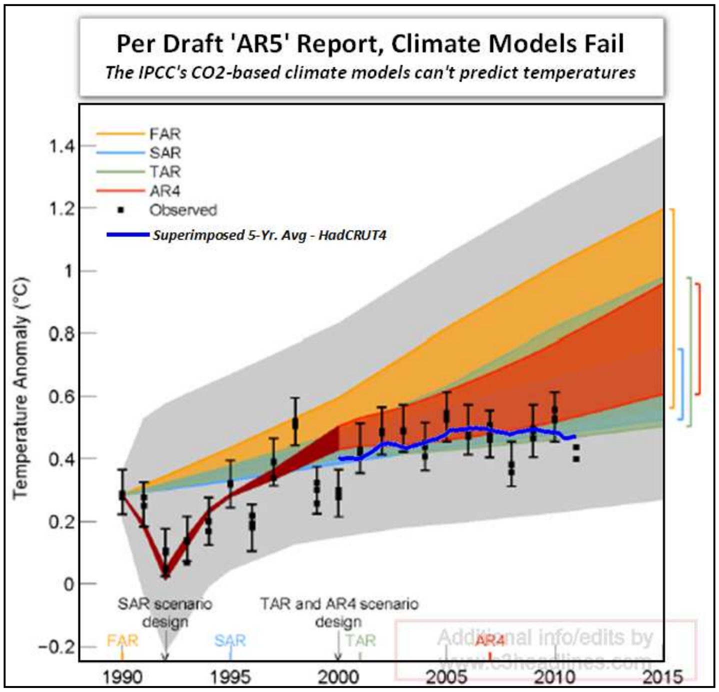

Figure 1. The superimposed 5-Yr. average temperature track is apparently not following the IPCC projected range. (C3Headlines, 2013)

IPCC opponents have also resisted the authority of the scientific community, bristling at the perceived increase in dictatorial, normative, and prescriptive language used in scientific communication. The American Enterprise Institute published the chart below (see Figure 2) in a 2010 article, *Science Turns Authoritarian* (K. P. Green & Alaghebandian, 2010), claiming that society was increasingly bombarded with dictates based on science, and that scientists were behaving more like partisans and less like objective scientists, particularly in climate science. At least one scholarly review has debunked this argument (Tobis, 2010), but internal scientific standards have not been sufficient to maintain public trust in scientific credibility and authority. For example:

leaked emails at the Climatic Research Unit at the University of East Anglia in the United Kingdom during 2010 and the resulting bad publicity made many non-scientists conclude that climate scientists were hiding unfavorable data in order to pursue a partisan agenda. Two separate internal reviews cleared the East Anglia scientists of wrongdoing, but the incident was a global scandal, and public trust in science and public acceptance of climate science declined in the leak's aftermath (Jasanoff, 2010; Ward, 2010).

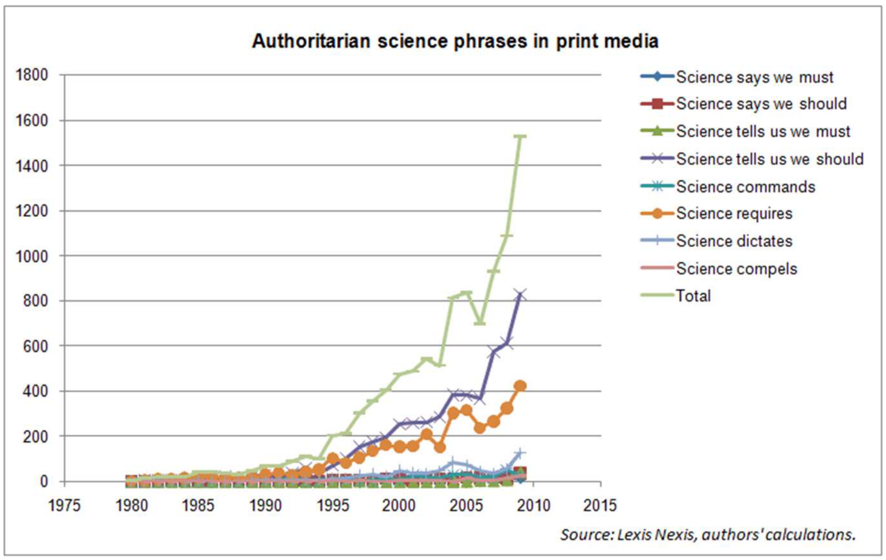

Figure 2. plots the increase in authoritarian language used by scientists (K. P. Green & Alaghebandian, 2010)

Climate scientists' credibility and authority to prescribe actions for society continues to be under persistent attack from economic and political interests that are threatened by climate scientist's proposals to limit climate change. Public and political will for climate policy in the U.S. lags the scientific consensus recommendations, the U.S. Congress has not enacted climate policy, and global emissions of GHG continues to rise sharply (IPCC, 2013b). The scientific community's climate change communication

(CCC) strategy has thus far failed to sufficiently convince the world at large, and especially Americans, of the dangers of climate change and the need to take action.

My research examines current CCC practice to better understand the effects and challenges that occur when scientists are advocating or are thought to be advocating. In CCC practice many climate scientists engage in advocacy, which waives objectivity, neutrality, and disinterestedness. I argue that the assumption that science is credible and authoritative based on traditional scientific objectivity and neutrality is an illogical foundation for scientist advocacy. I propose that scientists consider advocacy strategies from other disciplines that do not presume credibility or authority. Boundary organizations in science, which are designed to span organizational, intellectual, and values barriers, have demonstrated the necessity to develop credibility, saliency, and legitimacy with their audiences as a precondition for effective stakeholder engagement (Clark et al., 2011). The business community considers sales to be a boundary function, bridging between vendor and customer to develop mutually beneficial agreements. While there is resistance within the scientific community to the idea (AAAS, 2012), I propose that business to business (B2B) communication in customer service, essentially sales, can provide more effective strategies for scientist advocacy than solely relying on scientific credibility and authority. In sales, credibility is continuously negotiated with the customer and is dependent upon the emergent relationship between vendor and customer. I argue that stakeholder engagement strategies may be improved with the norms of results oriented management which offer sustainability scientists organizational principles that have been shown to improve results attainment.

Aim

The aim of my research is to diagnose weaknesses in present sustainability communication practices, as manifested in CCC, and to propose other strategies to help scientists who choose to advocate do so more persuasively. However, there remains a great deal of uncertainty regarding precisely what comprises scientist advocacy and whether or not scientists should advocate. Furthermore, there remain unreconciled conflicts between the normative dimension of sustainability and the social norms of science that call for objectivity, neutrality and disinterestedness. These are problems of significant proportion and while I propose interdisciplinary knowledge that may have potential to improve persuasive communication effectiveness, the scope of a dissertation is insufficient to deal conclusively with the normative and definitional dissonance regarding scientist advocacy. Instead, this research has focused on unearthing a problem set as a means to open a discussion about scientist advocacy in sustainability.

Scope

I examined scientist advocacy in sustainability within the context of climate change. Because climate change is a sustainability problem, scientist advocacy in climate science is essentially scientist advocacy in sustainability, and my research may be generalizable to scientist advocacy on other sustainability problems. This dissertation includes a review of the scholarly literature about advocacy, about the normative role in sustainability, and about the present CCC milieu. Scholars exhibit wide disagreement on the ethics and conception of advocacy and I do not attempt to resolve this dispute. Nor do I attempt to definitively establish precisely what behavior comprises scientist advocacy.

Instead, I propose a new way to think about advocacy that offers opportunity for scientists to improve their persuasive skills and become more effective advocates.

My empirical study includes a content analysis of IPCC communication in which I used the scholarly literature to develop a conceptual definition for scientist advocacy in order to contemplate its prevalence in CCC. My original research continues with the analysis of interviews with scientists and non-scientists who were professionally engaged in CCC. The analysis of IPCC communication and the interviews reveals an incoherent and problematic present conception and practice of scientist advocacy in CCC and in sustainability. In my conclusion I synthesize the preceding chapters and propose that the boundary spanning norms of strategic planning, results-oriented management, and B2B sales comprise a useful strategic and tactical approach to advocacy in climate science and in sustainability.

Overview of the study

The first four chapters of this study provide background and context for the original research presented in the last three chapters. Chapter One introduces the problem. Chapter Two examines scholarly views on scientist advocacy. Chapter Three examines the normative role of sustainability science. Chapter Four describes theories of science communication and discusses current CCC practice. Chapter Five analyzes the content of CCC seen from the IPCC. Chapter Six presents and analyzes the results of twenty-one structured interviews with professional climate science communicators. Chapter Seven concludes with a synthesis of my research. I discuss how my findings can be applied to climate change and sustainability communication. I discuss the limitations of my research and identify opportunities for future research relating to advocacy in sustainability.

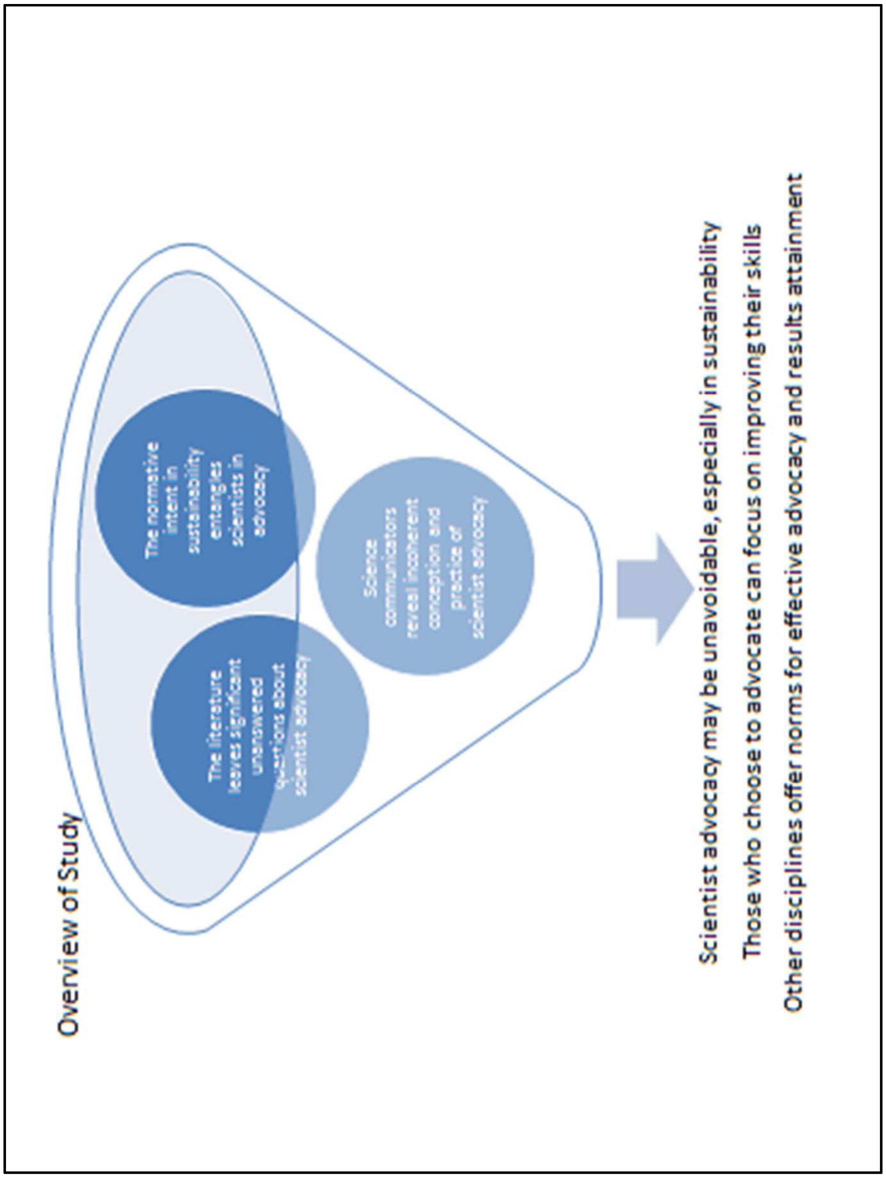

Figure 3. Overview of the Study.

CHAPTER 2

SCHOLARLY PERSPECTIVES ON SCIENTIST ADVOCACY

Introduction

Chapter 2 examines the scholarly literature that deals with scientists advocating in favor of particular outcomes that are related to their research. Examples include arguing for climate change mitigation, environmental protection, sustainable development; either generally or for specific policy proposals. After introducing the subject and providing historical background, the chapter explores scholarly definitions for advocacy, and arguments about whether or not scientists should or do advocate, or whether scientists can ultimately avoid advocacy. Finally the chapter synthesizes the literature and draws conclusions.

Scientists routinely engage in internal advocacy, for example, by applying for a grant, supporting a graduate student, or persuading colleagues of their theories or points of view, or they may advocate for more funding or autonomy for the scientific enterprise in general (Steneck, 2012). These varieties of advocacy are not of interest in this dissertation because they are common in science, do not bear significant direct implications to society, and the related policy issues are largely benign. Instead, I am interested in the growing prevalence of scientists advocating for a specific policy such as carbon-trading, or for a class of policies like GHG reduction. In this kind of advocacy, scientists argue in favor of policy or action that they deem necessary for the betterment of society. This kind of advocacy can become controversial and meet with social and political resistance. Some scholars refer to it as *scientist advocacy* and I will use that term henceforth in this dissertation.

Scientific research is commonly funded by the public, through the government, and many scientists feel an obligation to contribute to the greater social good and therefore advocate for action or policy that they believe would reduce dangers to society that they discovered through their research. Yet, the conception of advocacy within the scientific community is incoherent, and its practice undeveloped. The scholarly literature reveals a common understanding that scientist advocacy involves supporting or arguing in favor of something, for example: social change or policy action. But there is no scholarly agreement about what specific scientist behavior is and is not advocacy. Advocacy in science is important because it conflicts with broad prevailing conceptions about what science is, and how scientists should behave.

Historical Background

For more than 100 years, environmental scientists have debated about whether they must remain neutral observers of the environment or whether they are morally obliged to advocate against environmental degradation. By the mid-twentieth century, scientists advocating against environmental degradation began to gain pubic recognition. Rachel Carson's 1962 book *Silent Spring* described environmental degradation caused by man-made chemicals, and brought scientist advocacy to the public in an unprecedented way (Carson, 1962). Many view Carson's book as the birth of the environmental movement, in which society conceded a great deal to the authority of science and responded with an explosion of pro-environmental action. Carson's writing is emblematic of an important transition in which science began to assume a visibly critical and proscriptive role in society.

However, scientist advocacy for policies to conserve, preserve, and reclaim the environment began to be controversial with the rapid growth of environmental regulation during the 1970's, and the era of innocence for scientist advocacy waned (Jasanoff, 1987). Political conservatives, who in 1974 trusted science more than either moderates or liberals, bristled at the mounting regulation; and by 2010 they trusted science less than moderates or liberals (Gauchat, 2012). Scientist advocacy has become more controversial with the increasing incidence and scope of environmental policy proposals, such as climate-change mitigation, and the issue of scientist advocacy has become one of public importance, and one that sparks contentious debate (Jasanoff, 2010; Ward, 2010).

Carl Sagan's campaign against President Reagan's anti-ballistic missile shield is an example of controversial scientist advocacy. In the mid 1980's, a group led by Sagan campaigned against President Reagan's Strategic Defense Initiative (SDI). The scientists thought that SDI would make nuclear war more likely, which would result in environmental catastrophe; not only from war but due to a rapid global cooling they called *nuclear winter*. They used climate research about the cooling effect of aerosols to predict that sustained winter conditions would engulf the Earth as the result of even a modest nuclear exchange. Before the work was peer-reviewed Sagan published in the Sunday New York Times magazine on the subject and created a sensation. However upon review, Sagan was found to have published data from the top of the error bars and was forced to concede the cooling outcome of nuclear war was just as likely to result only in a modest cooling or a *nuclear autumn* (Oreskes & Conway, 2010). In his advocacy, Sagan waived objectivity, neutrality, and disinterestedness and exaggerated his research results. This was controversial within society and the scientific community and proved disastrous to Sagan's scientific credibility on the subject. Although Oreskes and Conway reported the episode in their 2010 book *Merchants of Doubt*, Oreskes did not recognize Sagan's loss of credibility as important and she later defended his exaggeration of the data as justified to adequately express the danger to society (Oreskes, 2013).

Much has been written about whether scientists should remain neutral and objective, or whether they may or should advocate. The literature on scientist advocacy is extensive but divergent, revealing a range of views, many of which espouse conflicting normative perspectives. Many scholars recognize that scientists should avoid advocacy in order to preserve their credibility as reliable sources of objective scientific information (AAAS, 2012; Edwards, 2013; Jasanoff, 1987; Merton, 1973; Mulkay, 1976; Sarewitz, 2011, 2012; Steneck, 2012). In Jasanoff's words: "The authority of science is seriously jeopardized when scientists are called upon to participate in policy-making" (Jasanoff, 1987, p. 197). Other scholars consider advocacy and science to be inextricably linked—both are socially relevant and commonly founded on concern for human wellbeing—and therefore science cannot be kept separate from advocacy about what courses of action will be best for humans. In this light some scholars argue that scientists have a moral obligation to advocate to the best of their ability to prevent the social harms that might arise if they did not advocate (Kaiser, 2000). Adding to the confusing array of normative perspectives is the fact that the scientific community has not precisely defined scientist advocacy.

Defining Scientist Advocacy

The question of whether or not scientists are advocating depends on how scientist advocacy is defined. Scientist advocacy is broadly understood to occur when scientists support a specific policy or a class of policies, but the scientific community does not agree about exactly what behavior constitutes advocacy. Some scholars hold that scientist advocacy comprises more than just communicating research results through routine scientific-communication channels, and that it must also include consciously promoting, developing, or assessing policy (Lackey, 2007; Nelson, 2009). Others point out that scientist advocacy can occur inadvertently whenever the scientist is unaware that he or she is advocating. Such situations may give rise to the possibility of covert or unintentional advocacy for a policy or a class of policies (Lackey, 2007; Sarewitz, 2012).

With growing interest in and controversy surrounding scientist advocacy, the American Association for the Advancement of Science (AAAS) convened a conference workshop on *Advocacy in Science* to examine the subject (AAAS, 2012). While the workshop did not produce a consensus AAAS statement, the proceedings help to illustrate the difficulty of defining scientist advocacy. Workshop conferees thought that advocacy for a specific policy included any attempt to influence an outcome—"to tell an external stakeholder, 'This is what you should do!' It is a deliberate, purposeful, public expression of an opinion or point of view" (AAAS, 2012, p. 2). This perspective does not exempt from advocacy any statements of opinion that are linguistically structured to be objective and that do not technically support any policy. The 1989 AAAS policy on lobbying defined it as: "Grass roots lobbying generally is any attempt to influence any legislation through an attempt to affect the opinions of the general public" (AAAS, 1989). Under the AAAS guidance on lobbying, it would be very difficult for a scientist to publicly express their opinion relating to a policy without being thought to advocate in some way.

Other scholars claim that making a statement that is or might be relevant to policy is not the same as advocacy, and that the speaker's intent determines whether or not they are advocating. Take, for example this statement: “If the goal is to reduce climate change then we must reduce emissions.” Some scientists consider such a statement to be objective and neutral because it doesn’t directly stipulate specific policy (J.M. Scott & Rachlow, 2011). The IPCC takes this position; in 2011 it established a formal communication policy that recognizes the need to remain objective in order to preserve credibility and the Fifth Assessment Report (AR5) *Physical Science Basis; Executive Summary* contains an exemplary objectively structured statement. Excerpts from IPCC communication policy and the AR5 quote are found below:

> IPCC Communication Policy, 2011:
>
> The remit of the strategy – as described in the Guidance – is to support the “ability of the IPCC spokespersons to provide neutral and objective statements that are grounded in the assessments reports” as “this will be essential to preserving the trust and confidence placed in the IPCC by decisions makers and other key audiences.” (IPCC, 2011c, p. 23)
>
> IPCC AR5 Physical Science Basis; Executive Summary:
>
> Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions (IPCC, 2013b, p. 19).

The 2013 statement from the IPCC was structured to be neutral and objective but it is normative and it supports the policy of emissions reduction which some scholars believe is advocacy. Although stated as fact, both sentences are actually opinion. Climate change is politically contentious and any expression of opinion in contentious political contexts will be seen as advocacy despite the attempt to remain objective (Sarewitz, 2012). Thus, although scientists and scholars do not agree what exactly constitutes advocacy, the scientific community provides a variety of arguments in favor of or against scientist advocacy. I'll first examine arguments against scientist advocacy.

Arguments against Scientist Advocacy

During the 20th century, philosophers of science developed for scientists a framework of behavioral norms that were thought to ensure the integrity, credibility, and reliability of science. Merton (1949, 1973) proposed institutional imperatives for the sociology of science, which included objectivity, neutrality, and disinterestedness. Merton argued that without disinterestedness, the expert authority of scientists could be abused in the pursuit of a partisan agenda (Merton, 1973), thus defining a clear conflict between Mertonian norms and scientist advocacy. Scientific credibility is thought to be the ability for scientists to inspire trust in their work, and objectivity, neutrality and disinterestedness are thought to be necessary to establish and maintain credibility.

Other scholars have argued that scientific credibility was a special variety, one that was strictly internal, among scientists; and that attacks on scientific credibility by non-scientists should be ignored (Nelson, 2009). This view, however, seems problematic considering that non-scientists' attacks on the credibility of climate science have damaged public trust in science (Jasanoff, 2010; Ward, 2010). Philosophers of science continue to debate the necessity and attainability of the Mertonian norms and I will not engage in that debate. Suffice it here to note that many scholars continue to insist that scientific objectivity, neutrality, and disinterestedness remain essential to preserving scientific credibility and that advocacy contravenes every one of these. Hence, according to them, advocacy by scientists damages scientific credibility, with the public losing trust in scientists who are thought to be acting as partisans and advocating.

Jon Krosnick (2012) confirmed that people lost trust in scientists and doubted the facts of their science even when scientists only assessed policy options without openly advocating. In his study, public trust in science declined in every measure when scientists offered policy advice. When contrasted with the views of respondents who had heard scientists only discussing climate science, those who had viewed scientists also offering policy advice recorded:

1. Lower trust in what the scientists said.
2. Lower perceptions of the accuracy of what the scientist said.
3. A lower percent of scientists the respondent trusted.
4. A reduction in the amount of government action the respondents thought was required to address climate change.
5. A reduction in the percent of respondents that would endorse ten different policies to reduce emissions.
6. A reduction in the percent of respondents that believed in the existence of climate change.
7. A reduction in the percent of respondents that believed that climate change was caused by human activity.

(Krosnick, 2012).

The implications of Krosnick's work are important: Public audiences decide when scientists are operating in areas outside of their expertise. Scientists' credibility with public audiences is negatively impacted when they weigh in on policy issues, which forebodes attempts the scientific community may undertake to persuade society beyond the facts of the science. Scientists' credibility with public audiences on matters beyond the underlying science is not mediated by the credibility and authority of the underlying science.

The basis for most arguments against scientist advocacy is that it conflicts with aspects of science; including the basis for scientific credibility and the widely held perception that science is an objective and neutral endeavor. On this subject, Sheila Jasanoff (1987) wrote:

> Much of the authority of science in the twentieth century rests as well on its success in persuading decision-makers and the public that the Mertonian norms present an accurate picture of the way science 'really works'. Unlike politics, science is 'disinterested' and 'objective' and, unlike religion, it is 'skeptical'. Accordingly, alone among major social institutions, science is believed capable of delivering a true picture of the physical world. Scientists have been quite successful in protecting this claim of exclusivity, jealously guarding their power to define the public image of science, and warding off competing claims by rival disciplines, particularly religion and various manifestations of 'pseudo-science' (Jasanoff, 1987, p. 196).

The essence of this argument against scientist advocacy can be summed up as follows: The scientific community, and to some degree society, perceive that scientific inquiry produces factual information that forms an empirical basis for developing scientific knowledge. The reliability of this scientific knowledge depends upon accurate and impartial observation. Scientific credibility relies upon scientists establishing and maintaining their objectivity and neutrality. When scientists demonstrate a personal interest in the outcomes of their science, when they become advocates, they waive objectivity and neutrality and bring into question their credibility and the empirical basis for their conclusions. For these reasons, many scholars claim that scientists should avoid advocacy because it undermines scientific credibility and authority (AAAS, 2012; Edwards, 2013; Jasanoff, 1987; Lackey, 2007; Merton, 1973; Mills, 2001; Mulkay, 1976; Nielsen, 2001; Rykiel, 2001; Sarewitz, 2011, 2012; Steneck, 2012; Tomasso, 2007; Wiens, 1996). The climate scientist Tamsin Edwards is unequivocal on the subject:

> I believe advocacy by climate scientists has damaged trust in the science. We risk our credibility, our reputation for objectivity, if we are not absolutely neutral. At the very least, it leaves us open to criticism. I find much climate skepticism is driven by a belief that environmental activism has influenced how scientists gather and interpret evidence (Edwards, 2013).

Another argument against scientist advocacy is that it is incompatible with the very nature of science. This argument asserts that science is objective and therefore irreconcilable with advocacy, which is subjective. Much of this argument relates to the differences between science and policy. Scientific findings are assumed to be fact-based, neutral, impartial, objective, relatively certain, and narrowly defined. Policy is thought to be informed by values, biases, opinion, uncertainty, and the need to include information that is beyond the scope of the science. For example, science is not asked to decree that something is 'good' or 'bad,' but policy questions often force such designations (Rosenzweig, 2001). However, the argument that science is entirely objective and advocacy is entirely subjective does not hold up. Both policy and science involve objective and subjective questions. For example; environmental management decisions often deal with the idea of *natural regulation*, which involves objective elements of the scientific concept of *regulation* along with subjective philosophical elements associated with defining *natural.* Scientists also wrestle with unavoidably subjective questions, such as defining an *endangered species*, a *sustainable harvest*, and *ecological restoration* (Huff, 1999). In these ways, scientists often commingle subjective and objective questions in their work, which undermines the argument that science is purely objective as a rationale for avoiding advocacy.

Many scholars argue that science and advocacy are simply separate and dissimilar activities (Martin, 2006; N. H. McCoy & Atwood, 2005; Nielsen, 2001; Tracy, 1996; Wiens, 1996). The extreme form of this argument claims that advocates speak out in favor of something, while scientists do not speak in favor of anything; that advocates care about their causes, while scientists are ambivalent about their hypotheses (E. McCoy, 1996).

An argument that society may make against scientist advocacy is that scientists may be inclined to advocate based purely on the scientific assessment when policy decisions routinely require the negotiation of both facts and values. Part of the argument for scientific neutrality holds that if policy-makers rely on scientist's views in areas beyond the scientist's expertise, they risk making poor decisions (Steneck, 2012). This argument implies that scientists should give advice only in the areas of their scientific expertise, but policy decisions often cannot be made based on science alone. Pielke Jr. (2007) argues that only in the simplest of contexts can facts dictate action. He calls this *Tornado Politics*, and explains it as follows: A tornado is approaching (uncontested fact); everybody wants to survive (uncontested values); everybody wants to get to shelter (uncontested course of action) (Pielke Jr., 2007). Policy challenges are almost never that simple, and the scientific assessment alone, however reliable, may be insufficient to decide policy controversies.[5] Sarewitz (2004) used the 2000 U.S. presidential election to point out that even the simplest of questions can sometimes not be resolved by fact but must be mediated by judgment. The simple numeric question of which candidate, Al Gore or George Bush, received the most votes in Florida could not ultimately decide the outcome. The U.S. Supreme Court stopped the counting of hanging chads, etc., and was required to make the decision not withstanding which candidate received more votes (Sarewitz, 2004).

Arguments for Scientist Advocacy

While many scholars claim that scientists should never advocate, others argue that scientist advocacy may be justified in some circumstances. In this argument, scientific neutrality is context dependent, requiring nuance and care to articulate appropriately (Coady, 1993). For these scientists, neutrality towards policy questions with dire consequences, such as climate change, may be personally repugnant in the same way that it would be repugnant to be neutral about child abuse. While the social norms of science call for neutrality, it may only be appropriate in the absence of moral consequences.

In the presence of moral consequences, scholars argue that scientist advocacy is appropriate in order to prevent the social harm that might occur if they failed to advocate (Kaiser, 2000; Lubchenko, 1998; Noss, 1992). In this argument, scientists may have an obligation to advocate based on possessing greater knowledge about the potential harm.

[5] In a related rationale, society may argue that scientists should not advocate because of continued uncertainty about their science. While scientists and scholars accept that science may never completely remove uncertainty, society is less cognizant about this aspect of science. However, this debate manifests more to the credibility of the science in question than to a categorical argument against scientist advocacy. To wit, climate scientists and climate change deniers continually argue about the credibility of climate science and whether there is enough scientific certainty about climate change to justify the proposed mitigation policies.

The argument is based in the rationale that scientists as citizens are morally obliged to serve society, and part of that obligation is to work to avoid social harm. It is also thought unethical for societies to prohibit scientists from participating in the fundamental rights and responsibilities that all citizens enjoy and that the moral weight to advocate outweighs any conflict that might exist between advocacy and science.

Other scientists argue that the dichotomy between neutrality and advocacy - facts and values - is false, and advocacy in science is nearly unavoidable. They use this logic to justify scientist advocacy. (Barry, 1996; Decker, 1991; Ehrlich, 2000; Freyfogle, 2002; Kaiser, 2000; Rutburg, 2001). The core of this argument is that science is unavoidably value-laden and that scientists make value judgments as a matter of their routine, therefore scientists cannot logically be precluded from advocacy on the basis that it is value-laden.

The arguments for and against scientist advocacy are varied and reflect divergent scholarly perspectives on the subject. The 2011 AAAS workshop on scientist advocacy recognized that the scientific views on advocacy were inconclusive and did not form a coherent argument either for or against scientist advocacy. However, the AAAS also recognized the growing prevalence and controversy of scientist advocacy, and recommended additional research to understand it, to improve the effectiveness of scientists who advocate, and to develop ethical norms to guide scientists who engage in advocacy.

Ethics for Scientist Advocacy

The process in which scientists advocate within their profession, for grants or in support of their theories, is governed by rules and guidelines such as peer review and grant application processes, but few guidelines or rules are available for scientists when they advocate outside of their profession. Steneck (2012) proposed that a set of norms might be developed using existing policies for scientific conduct in research as a basis for advocacy outside the profession (Steneck, 2012). Some scholars question whether the norms for scientific conduct would be a good fit for scientist advocacy, while others decry the restrictions that rules would impose and prefer that scientists be free to advocate in any manner they chose (AAAS, 2012). NASA scientist Gavin Schmidt (2103) argued that scientists must provide their expertise to society otherwise the void would be filled by ignorance but he argued for specific behavioral norms for responsible scientist advocacy (Schmidt, 2013). The subject of responsible scientist advocacy is not entirely new and Schmidt cited the Stanford scientist Stephen Schneider who had earlier argued for norms to guide scientists when they choose to advocate (S. Schneider, 1996).

Many scientific societies play an advocacy role and provide practical and normative guidance for their members on advocacy, but their organizational purposes are divergent and so is their guidance on advocacy. Some societies eschew advocacy, others promote it and provide assistance to their members for when they interact with society and policy-makers. For example, Federation of Associations in Behavioral and Brain Sciences (FABBS) has an Advocacy Division whose stated purpose is to issue public statements in support of behavioral and brain science and to provide guidance for taking action in advocacy by providing how-to information and links for contacting elected representatives regarding issues about science. The Ecological Society of America (ESA) through their Advocacy Division provides ESA letters, Capitol Hill briefings, congressional visits, and participates in coalitions. In addition, they provide policy resources on how to take action, contact Congress, and offer a team of rapid response experts (AAAS, 2013).

Establishing norms for scientist advocacy is complicated by the absence of a unified or precise definition of scientist advocacy. Some scientists have resisted the idea of working toward a single definition for scientist advocacy and preferred to just avoid the word advocacy altogether, because of perceived negative connotations with it (AAAS, 2012). Clearly more work is needed to provide ethical guidance for scientist advocacy but that is beyond the scope of this dissertation and I will leave that to other scholars.

Scientist Advocacy may be Unavoidable

Some scientists persist in the notion that science and advocacy are distinct activities. Scientists perform research, and explain their results, and may even engage in policy advice - all of which they believe do not involve advocacy unless the scientists also urge a particular course of action (Hixon, 2000; Lackey, 2007; Pielke Jr., 2007; J. M. Scott et al., 2007; Steneck, 2012). However, some scholars have argued that even advising policy-makers about the implications of their scientific findings should be considered advocating:

> Even to merely provide policy-relevant information unavoidably involves interpreting, filtering, and synthesizing facts. Although this processing of facts falls within the purview of scientists, it is not a purely objective activity as implied when scientists say they are merely providing facts. Insomuch as interpreting, filtering, and synthesizing facts is a normative activity, providing facts routinely represents advocacy for some position. Consequently policy assessment and the provision of policy related facts would seem to be kinds of advocacy… If so, advocacy by scientists would seem nearly unavoidable, and scientists might be wiser to better understand what constitutes appropriate advocacy and expend less effort pondering

whether they should advocate… Perhaps scientists are unqualified to recognize the value-ladenness of merely providing facts". (Nelson, 2009, p. 1096)

Sarewitz (2012) argued that in post-normal[6] environmental controversies -- when the stakes are high, the facts are uncertain, action is urgent, and values are contested -- scientist advocacy is unavoidable. Scientists may then find themselves occupying a position of advocacy from which no claims of neutrality or disinterest can exempt them. In these conditions, scientists do not need to explicitly support a particular policy to be perceived as an advocate, they need only assert their scientific facts in the presence of competing scientific facts. In post-normal conditions, neutrality can only be achieved by refusing to comment or participate in the debate in any way (Sarewitz, 2012), a position that many scientists feel they cannot ethically abide. Furthermore, refraining from taking a position about detrimental prevailing conditions that are favored by the dominant cultural and institutional interests may comprise de facto support for the status quo. For some environmental scientists, phenomena like climate change are clearly bad, scientists should know that they are bad, and they delude themselves by thinking they can take a neutral position. Sarewitz (2012) argued that scientists may be covert, or inadvertent, advocates, and that they should not continue to pretend that they can remain neutral in divisive controversies (Sarewitz, 2012).

To make this point, Sarewitz (2012) used a hypothetical situation in which a sedimentologist finds an unconformity in a local fossil record and concludes that the

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[6] Funtowicz and Ravetz coined the term *post-normal science* in 1991, arguing that traditional problem-solving strategies are limited by the character of new global environmental problems in which decisions require evaluations of future states which are unknowable (Funtowicz, 1991). Kuhn (1962) articulated the concept of *normal science* in his book *The Structure of Scientific Revolutions* (Kuhn, 1962).

unconformity was the result of uneven erosion. The issue is of purely academic interest until the location is considered for siting a nuclear power plant and a geologist reviewing the professor's theory claims that the unconformity is actually an earth quake fault. At this point, the opinion of the sedimentologist is no longer merely academic, it now matters and the issue is in contention between those in favor of the power plant and those opposed. The sedimentologist, Sarewitz argues, can no longer have a neutral opinion; their perspective will be controversial and involuntarily support the nuclear plant or oppose it. The only way for the sedimentologist to not support one side or the other in the presence of such a controversy is to refuse to take any position whatsoever, in which case the scientist also waives their scientific expertise (Sarewitz, 2012). Similarly, Farrell (2011) argued that that in post-normal conditions scientists can no longer provide objective and value-free policy advice, instead the process becomes a political act (Farrell, 2011). It may be impossible for scientists to make an objective statement when, as with climate change, the problem involves such a broad array of values, and so much controversy.

Conclusion

Scientists are in positions similar to doctors and judges who are expected to be impartial and unbiased, and provide objective analyses through rational thought. But this expectation unavoidably results in their not just providing relevant facts but assessing the meaning of the facts, to create knowledge, resulting in their taking positions on how people should behave and be treated (Nelson, 2009). In this way, facts and values are inextricably linked. Like doctors and judges, scientists may not be able to avoid developing normative perspectives about policy options. IPCC communication policy specifies neutrality and objectivity, and scientists carefully word their reports to comply. Yet many IPCC scientists and senior administrators verbally advocate in favor of climate policy, which simultaneously erodes the panel's claim to neutrality and objectivity, and feeds an unproductive debate about IPCC neutrality and credibility.

Scientists who advocate face conflict with the social norms of science and the abiding void of coherent guidance about scientist advocacy. A synthesis of the related literature does not resolve important questions regarding exactly what comprises advocacy or whether scientists should engage in it. However some conclusions can be drawn:

1. With the growing interest in solving sustainability problems, such as climate change, deliberate scientist advocacy is becoming common. Scientists who advocate or are thought to advocate, suffer an attendant loss of credibility regardless of their individual opinion about whether or not they engage in the behavior.
2. Scientist advocacy is unavoidable in controversial problems such as climate change. When the science and the proposed solutions are closely linked, and when society is divided on the issue, it is impossible for scientists to take a neutral position, and they will align with one side or the other.
3. The behavioral norms of science do not prevent scientists from participating as citizens in solving problems that face society. However, this does not preclude scientists from suffering damage to their credibility if they advocate or if they are thought to advocate.
4. Many scientists feel a moral obligation to warn society of dangers that they discover through their research. While there is a distinction between risk

assessment and risk management, in controversial issues even risk assessment is tantamount to advocacy.

The literature offers a range of conceptions regarding scientist advocacy, most of which address the social norms of science in some way, but the results are divergent. At one extreme only direct lobbying in support of specific legislation is considered advocacy, exempting other forms of support for a desired outcome, and preserving compliance with the social norms of science. At the other extreme, scholars argue that any form of support for a desired outcome, even casual or inadvertent support, is advocacy.

However, none of these arguments prevent public audiences from losing trust in scientists when they venture beyond their scientific expertise. Scientists' credibility with the public is not mediated by scientistic rationalizations that parse definitions for advocacy. Public trust in science suffers when scientists participate in policy discussions, which presents challenges to the efforts of sustainability scientists when they advocate for implementing their solutions to problems such as climate change. Chapter three examines sustainability in more depth.

CHAPTER 3

THE NORMATIVE ROLE OF SUSTAINABILITY

Introduction

Chapter 3 examines the scholarly literature on the normative dimension of sustainability in which scientists develop and attempt to implement problem solutions for society. For example, in developing solutions, sustainability scientists must make normative decisions about the preferred future state. After introducing the subject and providing historical background, the chapter explores the challenges of the normative role envisioned for sustainability scientists, particularly the potential for scientists to engage in advocacy while developing and implementing the solutions that they develop. Finally the chapter synthesizes the literature and draws conclusions.

Chapter Two revealed the lack of coherent guidance for scientists regarding advocacy, and this chapter discusses the potential for scientist advocacy to manifest in sustainability. According to prevailing social expectations, scientists seek to understand and describe the nature and functioning of their research subjects from a fact-based and value-free perspective, and scientists avoid including personal interests in their research. According to this traditional understanding, a scientist studying an animal would endeavor to satisfy their academic interest, while accepting its existence, past development, and present state without judgment. Scientists would traditionally not be expected to decree what is good or bad about the animal, or to determine what changes should be made to it, or to decide whether it should exist at all. To this primarily descriptive function, sustainability science adds a prescriptive or normative role in which scientists also determine what might be problematic with the present state, and how the problem might be solved. The normative role places scientists in situations in which they will engage in the policy process and might advocate or be perceived to advocate.

The academic debate about scientist advocacy continues unresolved but this has not deterred sustainability scholars who have articulated an explicit normative role for sustainability that is likely to entangle scientists in advocacy. Sustainability ideally requires scientists to make judgments about problematic present states and to develop plans for transitions to preferable future states. More than just identifying solutions for sustainability problems, scholars expect sustainability scientists to engage decision-makers and society in order to persuade them to implement the solutions they develop. Other than to claim it for scientists, little attention has been given to the persuasive challenges the normative role presents to sustainability scientists.

Some scholars simply ascribe the normative dimension to sustainability without explicitly identifying the role solely for scientists (Wiek, Withycombe, & Redman, 2011). Others have argued for a new kind of science, for a normative function specifically for scientists (R. W. Kates et al., 2001). In a review of the literature on sustainability, Wiek (2011) identified five personal competencies necessary for those working in sustainability, one of which was normative competence. Some scholars have studied methods for improving stake-holder engagement (Talwar, Wiek, & Robinson, 2011), and boundary structures that might improve sustainability scientist's normative effectiveness (Clark et al., 2011), however, scientist advocacy has largely not been addressed in the context of sustainability.

Sustainability scientists habitually leverage their scientific credibility and authority when attempting a normative influence with society or decision-makers, such as

IPCC Chairman Rajendra Pachauri imploring the world to heed the increasingly credible recommendations of science to reduce GHG emissions (Pachauri, 2012). But the credibility of scientists suffers when they discuss solutions, and I argue that this represents an important barrier to the normative role envisioned for sustainability, and this barrier has received little scholarly attention.

Historical Background

The eighteenth century German forester Carl von Carlowitz proposed active human management to preserve the perpetual output of forest resources, and he is credited as being the first to use the term "sustainability" (Scoones, 2007). Likewise, modern sustainability involves active human management to preserve Earth's life-support systems indefinitely for future generations. The foundational philosophy of sustainability is to meet the needs of the present generation without compromising the needs of future generations (WCED, 1987). Scientists have determined that the air, water, and food needed for future generations may be threatened by current human practices, and that societies must take action now to prevent further environmental degradation and to protect Earth's life-support systems for the future (Goldstein, 2011). Humans have for millennia held various moral, ethical, philosophical, and practical ideas about caring for the environment, but sustainability adds to these the idea that human survival may be threatened unless societies identify and change their environmentally detrimental behavior. Modern sustainability involves economic elements such as sustainable development, and social elements such as the concept of sustainable livelihoods. However neither is relevant without a viable life-support system on Earth. In this sense, sustainability is fundamentally an environmental management challenge, and the history of environmental management involves normative elements that are inherent in sustainability.

By the early 20th century, some environmental scientists and political leaders were calling for an end to the idea of nature as an unlimited resource that could indefinitely absorb the impacts of exploitation. President Theodore Roosevelt's comments during his 1907 annual address reflect the growing realization that foresight and effective management would be required to preserve environmental resources for future generations:

> We must maintain for our civilization the adequate material basis without which that civilization cannot exist. We must show foresight, we must look ahead… there must be the look ahead, there must be a realization of the fact that to waste, to destroy, our natural resources, to skin and exhaust the land instead of using it so as to increase its usefulness, will result in undermining in the days of our children the very prosperity which we ought by right to hand down to them amplified and developed (Roosevelt).

Through most of the twentieth century, American environmental policy reflected the values and assessment found in Roosevelt's words. Normative judgments about how the environment should be managed mingled the philosophies espoused by John Muir and Gifford Pinchot. Both argued for environmental stewardship, but Muir thought nature should be preserved more for its intrinsic value, while Pinchot thought it should be conserved for its perpetual economic benefit to society (Meyer, 1997). National parks like Yosemite were established, aligning with Muir's philosophy by permanently foregoing the potential economic benefits of some areas in favor of preserving the land in its natural state for future generations. For some other lands, U.S. policy gave primacy to harvesting the natural resources needed for a prosperous country, while perpetuating the land's economic benefit, reflecting Pinchot's philosophy about conservation. In considering the same environmental challenges, Muir and Pinchot developed significantly different norms about how we should treat the environment, demonstrating the possible variance that could be found in normative judgments even among those in favor of protecting the environment.

At mid-century, the naturalist Aldo Leopold advocated a *land ethic*: "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise" (Leopold, 1949, pp. 224-225). The normative nature of the discourse about how humans should treat the environment ultimately evolved into a debate that formally recognized an ethical question. By the 1970's, this debate had become the sub-discipline of philosophy called Environmental Ethics. It is important to bear in mind how individual ethics, values, and philosophy enter into any discussion about how humans should treat the environment, and to contrast that with the traditional intent in science to develop knowledge that is based on empirical evidence.

Both before and shortly after World War Two, the scientific process was largely viewed to be objective and neutral and scientific communication priorities involved the tradition of peer review and publishing mainly in scientific journals. In this model, science produced research and communicated the results. It was a narrow, one-way, linear channel of communication. There would have been little public awareness of scientific progress except in the case of sensational events like the atomic bombing of Japanese cities, or medical advances like the invention of the polio vaccine.

But World War Two produced unprecedented government interest, funding, and discoveries through scientific research that prompted President Roosevelt's 1945 assignment for the head of the U.S. Office of Scientific Research and Development, Vannevar Bush, which was; "What can be done, consistent with military security, and with the prior approval of the military authorities, to make known to the world as soon as possible the contributions which have been made during our war effort to scientific knowledge?" (Bush, 1945). Bush's answer was that science was the next frontier and the rightful concern of government, which should fund research not just for national security but to fight disease and to improve public welfare. Bush imagined public welfare would include new, better and cheaper products and processes, such as DDT, which was first widely used as an insecticide in the 1940's and thought to be safe, but by the 1960's DDT was found to seriously harm the environment (EPA, 2012). And who could have imagined in 1945 that the fight against disease would later place scientists in conflict with tobacco companies?

In the post war period, research was perceived to provide scientific breakthroughs that improved products and processes and this perception left society with a positive view of science. Political ideologies were neutral about science, and politicians of both parties were deferential toward science (Gauchat, 2012). Political conservatism had for years been linked to environmental preservation and Republicans were more likely to be associated with conservation than democrats (Weart, 2008). In the post war years, the public perceived that scientists worked independently on projects of individual interest and made discoveries that eventually benefitted society. The scientific community had little direct influence on society, and the public enjoyed substantial trust in the scientific process. But this would change.

During the 1950's, public and political trust in science remained generally ascendant as science produced many advances that met Bush's conception of benefitting society. Cooperation between scientific experts and decision makers was unproblematic; scientists provided technical information which administrators used to make policy. The authority of science was related to the perception that science was dedicated to the Mertonian norms of objectivity, neutrality, and disinterestedness (Jasanoff, 1987). Scholars thought the nature of public trust in science was associated with its cultural achievements, its valuable expertise about how things worked or how to fight disease. Essentially, trust in science linked modern social systems with scientific progress and technical innovation. A few scholars began to wonder if there might be limits to the ascendant public trust in science, in which case distrust of excesses of power and authority might lead to public anxiety about science. But through the 1950's political parties and their respective ideologies continued to be fairly neutral and deferential about scientific research and the scientific community (Gauchat, 2012).

In spite of the ongoing interest during the 20th century in preserving nature's intrinsic and economic value, by mid-century scientists were discovering that environmental degradation was occurring in new and surprising ways. Rachel Carson's 1962 book, *Silent Spring*, alerted a large portion of the American public to unanticipated problems caused by the widespread use of pesticides and fertilizers. Carson argued that chemical products previously thought to harmlessly enhance modern lifestyles and economic productivity were concentrating upward in the food chain and threatening both the environment and human health (Carson, 1962).

During the 1960's, scientists increasingly challenged the view of modern technological innovation panaceas because they were discovering environmental degradation that, in their expert scientific view, was related to the technologies. Scientists leveraged their scientific credibility and authority to advocate against the environmental degradation they perceived, and in favor of changes that would protect the environment and humanity. In this way, scientists were using empirically tested science and their scientific authority as a basis for normative arguments in favor of better environmental stewardship. Public perceptions about science continued to include notions of neutrality, objectivity, credibility, and technical expertise that were employed in socially beneficial contributions to society, such as military or medical breakthroughs. A broad spectrum of society continued to defer to the authority of scientists (Gauchat, 2012), and environmental organizations, activists, philosophers, politicians, and academics joined in a discourse about environmental protection that coalesced into a social movement and mobilized society to halt and reverse environmental degradation (Johnson, 2006).

Sufficient numbers of the public and policy-makers were convinced of a looming environmental crisis to enact legislation to protect the environment. In 1969, the U.S. Congress passed the National Environmental Policy Act (NEPA) ". . . to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans" ("National Environmental Policy Act of 1969," 1970). The first "Earth Day" was celebrated in 1970, and a plethora of revised and new environmental legislation was enacted during the next decade: the Clean Air Amendments of 1970, the creation of the Environmental Protection Agency by President Nixon in 1970, the Federal Water Pollution Control Amendments of 1972, the Endangered Species Act of 1973, the Safe Drinking Water Act of 1974, the Resource Conservation and Recovery Act of 1976, the Surface Mining Control and Reclamation Act of 1977, and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 are examples (Goldstein, 2011).

Expanding environmental regulation was met with nascent but growing social and political resistance. By the end of the 1970's, this resistance had grown and was centered within the conservative political movement called the New Right (NR), which helped sweep Ronald Reagan into the Presidency in 1980. Strong post war perceptions of scientific neutrality began to erode with the growth of the NR, which consisted of an odd alliance of the religious right and corporations that had vested interests in scientific outcomes. The religious right opposed science on moral and epistemological grounds while business resisted the growth in regulation (Gauchat, 2012).

The 1970's brought fundamental change to the relationship between science and society. The expectation of Vannevar Bush that science would improve social welfare began to pay-off but in unexpected ways. In the 1960's, Rachel Carson's criticism of DDT was resisted by the chemical companies involved, but less so by society. By the close of the 1970's, the broad spate of new preventive policies that were implemented had garnered the attention of society and an energetic resistance to scientific prescriptions had commenced. The scientific community had become unavoidably involved in normative policy battles and yet persisted with a traditional self-perception that associated its authority with Mertonian norms including disinterestedness, objectivity and neutrality.

An aggressive role in policy development was actively engaged by the scientific community as a natural response to its discoveries, and emanated logically from perceived scientific authority. Science had discovered important new information about a host of risks facing society and leveraged its credibility and authority to advocate for changes that would improve social welfare. However, society was not as certain, its trust in science was no longer ascendant; political conservatives in particular had begun to challenge scientific authority.

In addition, critical theorists had begun to question the growing domination of science and technology in political decision-making. The development of democracies made possible the formation of public opinion as a legitimizing force in politics (Held, 1990). Habermas referred to this as the *public sphere* and observed its disintegration with the ascendance of scientific and technological rationale in political decision-making. To an increasing extent, military and technological advances led to the scientization of politics, and politicians began to discount societal values, goals, and needs in favor of a reductionist rationale. With the scientization of politics, decision-makers had become dependent on scientists for the objective assessment of problems, as well as for strategies and rules for resolution (Habermas, 1971). For some scholars, privileging scientific knowledge represented a technocratic ideology or scientism, and while it did not falsify reality in pursuit of particular interests, it was more pervasive than older ideologies. Moral, practical, and political questions were transformed into technical questions, diminishing the public sphere as a political institution and creating a system of scientific and technical domination of political decision-making (Outhwaite, 2009). Rather than address practical and moral questions, politicians increasingly invoked scientific exigencies to make political decisions. However, scientists had begun to encounter complex problems that defied simple solutions.

In the 1970's, scholars defined a distinction between ordinary *tame problems* and *wicked problems* (Rittel, 1973). The former, like engineering problems, had well-defined rules for resolution and it was possible to know when they had been solved. The latter were defined by a plurality of conceptions about the problem, biases of the stakeholders, unforeseen trade-offs, and unintended consequences that could not easily be reversed. Rittel and Webber, who coined the term *wicked problems* in their 1973 paper, *Dilemmas in a General Theory of Planning*, claimed that the solutions to wicked problems were always political and never settled with additional empirical research or new data, but rather had to be continually deliberated or continually re-solved. They argued that in a pluralistic society wicked problems could not be accurately defined, that the concept of indisputable public good did not exist, that equity could not be objectively defined, and there were therefore no definitive or objective solutions to wicked problems. Rittel and Webber thought science was ill-equipped to solve wicked problems, yet, sustainability scholars would later embrace the concept of wicked problems, and expand the purview of science to include economic and social problems and claim an active role for scientists in solving them.

Although sustainability has its roots in the environmental sciences, during the early 1980's, the discourse on sustainability began to include concerns about human well-being. Social and economic dimensions were added to the dialogue and the term *sustainable development* emerged (R.W. Kates, 2011). Sustainable development was the central idea behind the 1987 Brundtland Report, *Our Common Future* (WCED, 1987). It was addressed to the public and called for education, debate, and public participation. The Brundtland Commission's mandate was threefold:

1. To research critical environmental and developmental problems and develop solutions.
2. To develop new ideas for international co-operation that would move policies toward needed changes.
3. To improve understanding and increase commitment to action across global societies, and governments.

The Brundtland Report was a defining work amid the 1980's explosion of discourse about sustainability; it was adopted and promoted by a host of organizations within the United Nations, by NGO's, and in universities (Scoones, 2007). The Brundtland Report transformed the idea of merely sustaining the physical output of forests or fisheries, into the idea of global sustainable environmental, economic, and social development. Linking environmental preservation to economic and social development was the foundation of the "triple bottom line" concept: that sustainability is achieved when societies simultaneously achieve a sustainable economy, a sustainable environment, and a sustainable society (Mebratu, 1998).

The Brundtland Commission called for action to bring about the changes needed to achieve sustainability. Its mandate explicitly called for promoting the implementation of changes needed for sustainability and raising the level of commitment to action from individuals to governments. In other words, it enshrined a normative dimension for sustainability - to not just develop solutions or establish norms, but to promote the implementation of those solutions. Thus, sustainability was not only about discovering sustainability problems and finding solutions to them, but also about influencing values and goals, and raising the level of commitment to action. The normative role in sustainability has developed into an explicit expectation for practitioners and scientists to develop, promote, and implement their ideas for sustainable development.

Sustainability is Explicitly Normative

In his seminal 2001 paper "*Sustainability Science"* Robert Kates and his co-authors described the new field of sustainability science and established seven core questions for it. The first three questions dealt with the structure of scientific inquiry necessary for sustainability science, while the last four articulated a distinct normative role for sustainability science to:

- Define limits and boundaries.
- Establish incentive structures, markets, rules, and norms.
- Provide useful guidance and decision support.
- Teach society.

These challenges were specified as roles for sustainability scientists. The authors conclude the paper by arguing: “Third (and most important), research itself must be focused on the character of nature-society interactions, on our ability to guide those interactions along sustainable trajectories, and on ways of promoting the social learning that will be necessary to navigate the transition to sustainability” (R. W. Kates et al., 2001, p. 642). In "*What Kind of Science is Sustainability Science?"* (2011), Kates continues along the same lines: "…sustainability science is a different kind of science that is primarily use-inspired, as are agricultural and health sciences, with significant fundamental and applied knowledge components, and a commitment to moving such knowledge into societal action" (R.W. Kates, 2011, p. 19450). Wiek et al. (2011) argued for the importance of normative competence in sustainability, and defined it as:

> Normative competence is the ability to collectively map, specify, apply, reconcile, and negotiate sustainability values, principles, goals, and targets… Addressing sustainability problems and opportunities requires going beyond descriptive questions of how complex social-ecological systems have evolved, are currently functioning, and might further develop. The concept of sustainability is unavoidably value laden and normative, since it addresses the question of how social-ecological systems ought to be developed, so that they balance and even enhance socio-economic activities and environmental capacities (Wiek, Withycombe, & Redman, 2011, p. 209).

This quote is reminiscent of President Theodore Roosevelt's argument that society must manage its natural resources with foresight in order to provide for the needs of future generations. However, Roosevelt was arguing that the country as a whole negotiate how to do so, while sustainability scholars argued that scientists and practitioners diagnose the problems and direct the path to solving them. In the Wiek, Withycombe, and Redman (2011) review of sustainability literature, they cite many sources who recognize that sustainability "is problem driven and solution oriented… and links use-inspired knowledge to transformational action…" (Wiek, Withycombe, & Redman, 2011, p. 203). Grunwald (2004) wrote that "Sustainable development is a normative societal principle, and science makes indispensable contributions to its realization" (Grunwald, 2004, p. 152). Gibson (2006) argued that sustainability requires the ability to negotiate trade-off rules and specify decision criteria, and identify appropriate options for decision makers, including choosing courses of action (Gibson, 2006).

Science has long made an important contribution to environmental problem-solving and yet sustainability adds to this task a normative role for scientists to identify, specify, and choose actions to transform society towards sustainability. This role is primarily specified for sustainability scientists, to the exclusion of others in society. These scholars assume an unmistakable leadership role for scientists to diagnose problems, develop solutions, and persuade society to implement those solutions. There is some recognition that science cannot dictate action to society, yet there is little responsibility given to the rest of society for analyzing problems and developing solutions. The assumption appears to be that science is largely sufficient to the task.

Another example of the normative dimension of sustainability is provided by the Millennium Development Goals (UNDP, 2012). This extensive set of global development objectives includes the enumeration of current global social sustainability problems and a description of the preferred state via specific set of objectives. One of the goals is the reduction of poverty which is also reflected in the Proceedings of the National Academy of Sciences (PNAS) characterization of sustainability science as an emerging field of research, and defining sustainability as "… meeting the needs of present and future generations while substantially reducing poverty and conserving the planet's life-support systems" (PNAS, 2013). In this conception, sustainability necessarily involves decisions about trade-offs between the environment and poverty. For example; some scholars and many developing countries have argued for the continued use of cheap, but polluting fossil energy like coal, in order to lift populations out of poverty[7] before these countries should be required to adopt cleaner energy systems.

Considering that the roots of sustainability lie in perpetuating Earth's life-support systems, the addition of poverty reduction to sustainability challenges is intrinsically a normative consideration and involves additional challenges. For example: The San Bushmen have lived sustainably as hunter-gatherers on the Kalahari Desert for millennia but now face contradictory cultural survival agendas perpetrated by outsiders (Robins, 2001). No empirical scientific knowledge can determine the circumstances under which the San can be decreed poor or rich. Science cannot determine whether the San should be folded into a more western culture, or stripped of the vestiges of western civilization and returned to the Kalahari to live as hunter-gatherers. These decisions are value dependent. PNAS has published more than 300 scholarly articles in their section on sustainability science (Kates, 2011), which by their definition adds poverty reduction to the challenges that scientists are to tackle. Defining poverty, and deciding which peoples are poor, and

[7] China, now the world's leading emitter of GHG, makes this argument. Su Wei, a member of the Chinese delegation to the Conference of the Parties climate meetings in Qatar, told reporters in November, 2012: "For developed country parties like the U.S. and the European Union, the pledges and commitments put forward on the table are far below what is required by the science. And far below what is required by their historical responsibility. We are still in the process of industrialization. We are also confronted with the enormous task of poverty eradication. In order to eradicate poverty, to try to improve the living standards, certainly we need to develop our economy, so the emissions will need to grow for a period of time (Casey, 2012)".

what should be done to alleviate their poverty, and what kind of energy they will be permitted to use, are all normative questions which science alone cannot answer.

While it may seem logical that the scientists who discover sustainability problems apply their scientific expertise to develop solutions, questions about how social systems should evolve are unavoidably normative, and influenced by more than just the science of the problem. However, scholars idealizing sustainability largely assume that scientists will diagnose the problems, develop solutions, and persuade societies to action.

Conclusion

The scholarly literature on sustainability consistently implies or explicitly articulates a normative role for scientists to not only establish norms for preferred future states, but to persuade societies to abide by those norms. However, little scholarly discourse has been dedicated to the challenges and problems that arise when scientists attempt normative influence in society and are perceived as partisan actors advocating for select preferences. Kates et al (2001) called for participatory procedures "involving scientists, stakeholders, advocates, active citizens, and users of knowledge" (R. W. Kates et al., 2001, p. 641), and thought that combining different ways of knowing would catalyze advances in the abilities of different social actors to work together. In practice, combining difference ways of knowing has proven elusive, with scientists privileging scientific knowledge. Kates, et al proposed that scientists connect to the political process to influence decision-makers, but they offered little recognition that scientist advocacy might result, nor any specific strategy to operationalize their envisioned normative influence.

A consistent theme in the sustainability literature is that scientists, academics, and sustainability practitioners should influence how social-ecological systems ought to develop, but there is less discussion of whether that influence is appropriate or democratically produced. Cash et al. (2003) proposed that scientists must establish credibility in dealing with society on sustainability problems (Cash et al., 2003), but scientists have habitually relied instead on traditional, a priori, scientific credibility and authority. In studying attempts to reduce tropical deforestation, Clark (2011) discovered several distinct boundaries between scientists and stakeholders that had to be spanned in order to establish credibility, salience, and legitimacy in advance of the research activity. In some cases the deforestation research strategy envisioned and planned by scientists and funding organizations was not acceptable to stakeholders and had to be re-negotiated and adjusted in order to then proceed with the normative objective of curbing deforestation (Clark et al., 2011). These and other scholars have begun to tackle the practical challenges that have arisen in sustainability, but have largely not recognized the challenges of scientist advocacy that are likely to arise when scientists attempt to influence the development of social ecological systems.

While scholars have articulated a normative role for sustainability scientists, transitioning from empirically based research to implementing social change has proven more difficult than simply connecting to the political agenda. Climate scientists have determined that GHG pollution from human activity is contributing to dangerous climate change and arrived at the logical conclusion that GHG emissions should be reduced. The scientific findings tend to indicate the solution and climate scientists have used this calculus to advocate for emissions reductions for more than two decades. Climate scientists are connected to the political process via the IPCC whose purpose is to inform the climate policy process, but effective global action has been elusive and global GHG concentrations have continued to rise (IPCC, 2013b). The difficulty lies in articulating and negotiating normative questions about what action should be taken and this discourse ranges beyond the scientific assessment.

> For the scientific method can teach us nothing else beyond how facts are related to, and conditioned by, each other. The aspiration toward such objective knowledge belongs to the highest of which man is capable, and you will certainly not suspect me of wishing to belittle the achievements and the heroic efforts of man in this sphere. Yet it is equally clear that knowledge of what is does not open the door directly to what *should be* (Einstein, 1950).

Since Einstein wrote these words the environmental movement has blossomed into the triple-bottom-line conception of sustainability that sweeps in environmental, social, and economic challenges. From Brundtland through Kates to the present day, sustainability scholars have staked-out an ambitious normative role for science. Kates compared sustainability to other use-inspired science such as agriculture or health which also endeavors to move knowledge to action (R.W. Kates, 2011). However, agriculture and health challenges pale in comparison to sustainability because they are subsumed by it. The prescriptive reach of sustainability represents an important departure from traditional expectations throughout society about the role of science, and it is not clear that society will acquiesce. The sustainability literature reveals the abiding assumption that normative moral and political questions can be reduced to scientific questions, which some scholars characterize as the scientization of politics (Habermas, 1971) or the institutional idolatry of science (Wynne, 2006a).

Some sustainability scholars have suggested that solving sustainability problems will require dialogic negotiation among the stakeholders, yet scholars largely privilege science with the normative responsibility. The literature contains specificity regarding the role for scientists but comparatively little detail regarding the role for the other stakeholders. Scholars that have considered stakeholder engagement in detail have expressed concern that the involvement of stakeholders might compromise scientific integrity (Talwar et al., 2011), which despite the scholarly attention given to stakeholders, relegates them to a secondary role. As visualized in the literature, the role for diagnosing and solving sustainability problems is dominated by science, implying an authoritative flow of knowledge, values, principles, and goals from science to society (Wiek, Withycombe, & Redman, 2011). In practice however, segments of society have viewed scientists' prescriptions as authoritarian and resisted in numbers sufficient to create policy inertia, as is the case with climate change mitigation.

The literature on sustainability largely assumes that scientists will somehow successfully persuade society to follow their prescriptions, as though scientists need only demonstrate the truth of the science and people will agree to live by it (Jasanoff, 1999). Sustainability scholars have underestimated the challenges of the normative role and overestimated scientists' capabilities; leaving them unprepared for the persuasive communication challenges of negotiating society's transition to a sustainable trajectory. Sustainability scientists will require additional communication skills to more effectively realize the normative role that has been envisioned for them. The scientific community has begun to dedicate effort to improving sustainability communication and climate change communication (CCC) is exemplary. Chapter Four examines scholarly record on science communication in theory and in practice, and specifically in climate science to explore its development and challenges in more detail.

CHAPTER 4

SCIENCE COMMUNICATION AND CLIMATE CHANGE COMMUNICATION

Introduction

Chapter 4 examines the scholarly literature on science communication with a focus on climate change communication (CCC). The chapter explores the linear tendencies of science communication, its scholarly criticisms, and ideas for improving it. The chapter then turns to CCC because it is the context for this research and it has garnered a great deal of public, political, and academic attention. The IPCC is prominent in CCC and this section outlines the IPCC, the scholarly assessment of its communication practice, and considers IPCC communication strategy in light of the literature previously reviewed. Given the importance of climate change, significant questions relate to whether CCC has been impacted by the scholarly criticisms of and recommendations for science communication in general, and by the attention given to improving CCC. The chapter concludes with a synthesis of the literature reviewed.

How Science Provides its Expertise to Society

With the growth of the environmental movement and sustainability, science communication has transitioned from a primarily internal scientific function, dominated by peer review publishing, to a visible public and political act when scientists work to persuade society to take action to mitigate risk. Some scholars question whether science is alone capable of assessing or managing risks in society's best interest and suggest including input from all of the stakeholders. A common criticism found in the literature is that scientists tend to convey to society their knowledge and recommendations for action in a largely one-way flow from science to society and, scholars argue, with potentially disastrous consequences.

One of the more interesting analyses of the relationship between science and society can be found in Brian Wynne’s analysis of science-based restrictions imposed on Cumbrian sheep farmers in England following the Russian nuclear disaster at Chernobyl in 1986. The story takes place in the central highlands of England, in the vicinity of a cold-war era nuclear munitions and fuel processing facility at Sellafield that had suffered a major fire and release of radioactive cesium in 1957. The local population had been told very little about the accident but locals, including sheep farmers, had quietly suspected a perceived increase in the incidence of leukemia was related to the fire and long-term radiation leakage from the plant. Scientists and British government officials had assured them otherwise, and while the issue had ebbed, it had not gone away.

After the Chernobyl disaster, British authorities predicted a temporary contamination of the central highlands with radioactive cesium from the stricken Russian nuclear plant and required sheep farmers to keep their mutton and milk products off the market for a few weeks until the contamination was sufficiently diluted and absorbed into the soils. Scientists and government officials misapplied previous soil research and grossly underestimated the decontamination time, resulting in a series of increasingly draconian restrictions on the farmers, many of whom suffered serious financial and physical damage to their farming operations as a result. The scientists followed up with additional mistakes in soil and animal testing procedures that could have been avoided had they heeded the farmer’s local expertise on farming and weather patterns. Although the scientists' mistakes were exposed, they never admitted to them, continued to discount the farmers' knowledge and culture, and the farmers lost trust in the scientists and government. Wynne's assessment is:

> Trust, or trustworthiness, and credibility are relational terms, about the nature of the social relationships between the actors concerned. They are not intrinsic to either actor nor to the information said to be transmitted… … the best explanatory concepts for understanding public responses to scientific knowledge and advice are not trust and credibility *per se*, but the social relationships, networks and identities from which these are derived. If we view these social relationships as incomplete, and open to continual (re)construction through the negotiation of responses to social interventions such as the scientists represented, we can see trust and credibility more as contingent variables, influencing the uptake of knowledge, but dependent upon the nature of these evolving relationships and identities. (Wynne, 1992a, p. 282).

Wynne argued that the public acceptance of science depends on public trust in science, which is not a product inherent to the science but is rather a function of the relationship between the pubic and science. The scientific community defines credibility internally, according to scientific norms that may not be salient with the public or policy-makers. Rather, public acceptance of science depends on the credibility that the public is willing to invest in science, which is mediated by the nature of the social relationship between science and the public, it is not intrinsic to either party or to the scientific information conveyed (Wynne, 1992a). Scholars claim that scientists tend to assume that their science is inherently credible and that problems with the public acceptance of science are attributable to a public deficit of some sort.

The Deficit Model

Scholars who study the Public Understanding of Science (PUS) call this perspective the deficit model, in which problems in the public uptake of science necessary for effective risk assessment and risk management relate to the public's inability to comprehend the science, or a public deficit in scientific knowledge. "A deficit perspective works on the assumption that those without scientific knowledge have a deficit that needs to be filled through the one-way transmission of information from experts to learners" (Cooper, 2011, p. 231). Sheila Jasanoff described this as the linear view of science communication that assumes:

> …reasonable people the world over will perceive environmental threats and challenges in the same way, especially if they are shown how to look at them by science. This perspective on risk and its scientific representation asserts itself with the confidence of a supreme artist. Just let science show people the truth, and they will acknowledge its power and agree to live by it (Jasanoff, 1999, p. 148).

Studies concerning the PUS have pointed to the failure of the scientific community to accurately assess and effectively respond to the public, and have underlined the need to reconsider the assumed framework under which the scientific community engages the public (Wynne, 1992a, 1992b, 1993). Cooper (2011) claimed that democratic policy making requires that the public have trust in science in order to have any chance of dealing with urgent threats such as climate change. She suggested that science dispense with the notion that any shortfall in the public understanding of science be attributed to a public deficit and recommended more participative interaction between science and society (Cooper, 2011).

Proposed Improvements for Science Communication

A variety of improvements for science communication have been proposed, many of which involve increasing public or stakeholder engagement. The CAISE Inquiry Group Project argued that Public Engagement with Science (PES) was a necessary strategy to include the views of all publics and policy makers in the deliberation of scientific activity and policy, and emphasized mutual learning and participation (McCallie, 2009). Cash, et al proposed ideas for linking science to action in which scientific information should be relevant to stakeholders by being credible, salient, and legitimate. They found one-way communication, from scientists to society, ineffective and recommended a communication process that was active, iterative, and inclusive (Cash et al., 2003). Other scholars who have impugned the deficit model have called for more public engagement in scientific communication (Groffman et al., 2010; Talwar et al., 2011). However, while calling for the inclusion of other ways of knowing and the co-production of science with stakeholders, some scholars were simultaneously concerned about compromising the integrity of science with in-expert stakeholder involvement (Talwar et al., 2011). Other scholars have worried that a purely democratic development of science-based policy, unduly privileges inexpert perspectives and may lead to poor decision-making (Nelson, 2009). In discussing the democratic control of science, Kitcher (2003) argued that tutoring of decision-makers regarding policy-critical science would be necessary to avoid what he termed *vulgar democracy* in which ignorance or self-interest might be privileged (Kitcher, 2003). While some scholars express concern about involving non-experts in the production of scientific knowledge and in science-based decision-making, a great deal of the literature that is focused on improving science communication suggests two-way communication between scientists and stakeholders, and a greater role for stakeholders in policy related science.

A wide variety of examples can be found in which knowledge from other disciplines has been proposed to improve science communication. Some scholars have proposed using existing knowledge from the communication and behavior disciplines (Moser, 2010). Interpersonal competence, including advanced communication skills, has been identified as critical for sustainability practitioners (Wiek, Withycombe, Redman, & Mills, 2011). Research in facilitation suggests that ideologically divergent parties may be engaged productively through the co-creation of knowledge, which can produce relational empathy, new shared perceptions of the problem, and an emergent new culture (Broome, 1993). Cultural theorists who synthesized Mary Douglas' typology of social relationships to create a new framework of environmental and social rationalities suggested that people with different philosophies and varying ideologies were necessary to decision making and to creating innovative outcomes (Schwarz, 1990). Similarly, in his study of wildlife management in the Pacific Northwest, Swedlow (2012) documented the efforts to preserve the Spotted Owl, and showed how the social and cultural transformations that occurred were co-produced by scientists, judges, and environmentalists and suggested that the inter-relatedness of Mary Douglas' Four States may be necessary to the survival of each (Swedlow, 2012).

The discipline of psychology has been considered for the potential of various communication strategies in influencing environmental behavior. Stern (2000) studied how psychology might be used to influence behavior (Stern, 2000). Arvai and Gregory (2003) found that a values approach was more successful than a technical approach in aiding environmental decision making (Arvai, 2003). The psychologist Jonathan Haidt (2001) argued that reasoning with people may be less effective than appealing to a person's morals and values (Haidt, 2001). Similarly, Kahan (2014) argued that people were unable to reason both as pure knowledge seekers and as cultural competitors who were attempting to protect their social identity (Kahan, 2014). Other research found that ideology could foster factual misperceptions which factual corrections would not correct but might even strengthen in the most committed ideologues (Nyhan, 2010). In addition, scientists are also actively experimenting with ideas to improve science communication including the use of various communication models, media, framings, vernacular, and interactive simulations. (Falk, 2011; E. G. T. Green & Clemence, 2008; Nisbet, 2009; Sondergaard, 2003; Sterman, 2011). The efforts to apply psychology are noteworthy because they are largely intended to improve scientists' communication and do not address problems with linear communication that have been identified by other scholars.

Synthesis of the Literature on Science Communication

The literature on science communication contains emphatic criticism of the deficit model in favor of more participative approaches, but an abiding commitment in science communication remains the education of the public. Scholars have recognized that the public and policy-makers are not likely to support policy action without a clear conception of the critical science involved (Moser, 2010), thus reinforcing the need for effective science communication and an educated public. So while some of the literature devoted to improving science communication is critical of linear communication and the deficit model, some of it remains focused on facilitating the flow of knowledge from science to the public thus retaining some characteristics of the deficit model, making it difficult to discern the point at which linear communication might become hegemonic. The legitimate need for communicating science to the public may easily form inadvertent cover for the continuation of underlying premises about the public that are enshrined in the deficit model. On this point Wynne proclaimed: "So, the deficit model is dead – long live the deficit model!" (Wynne, 2008) p 23. Important questions remain regarding how science provides critical expertise to society without compromising the science, and how science may avoid a hegemonic imposition on the public of select values and goals. The latter, scholars have argued, can result in the public losing trust in science, regardless of the internal perceptions of the credibility of the underlying science.

In matters in which scientific knowledge is critical for good decision-making, it is in society's interest that scientists assert their expertise, or society may face increased danger due to the failure to respond appropriately to looming risk. The scientific community has struggled to convince society about the risk of climate change and many researchers have linked the importance of science communication and public understanding, to the possibility for taking climate-related policy action (Boykoff, 2007; Diemberger et al., 2012; Greenberg, 2011; Jasanoff, 2010). Because of its importance, scholars have devoted a great deal of attention to climate change communication (CCC), which will be examined next.

Climate Change Communication (CCC)

Climate scientists have achieved a significant consensus that human activity is causing dangerous climate change (Cook, 2013; Farnsworth, 2012; IPCC, 2013b; Oreskes, 2005), but a smaller proportion of the public and policy makers agree with the scientific assessment (Leiserowitz, 2012; PEW, 2013). The 2013 Cook study shows that

97% of actively publishing climate scientists believe that anthropogenic climate change is real but a 2013 PEW survey shows that only 54% of the American public accept anthropogenic climate change. Many scholars view this as a communication failure and climate change communication (CCC) has emerged as a growing sub-discipline of science communication.

Although research into the Earth's climate and global warming has been ongoing in the scientific community since the 19th century, CCC largely did not reach the public until the 1980's. Previously, most scientific research about climate had been performed by individual scientists or small groups and published through narrow scientific channels with little or no public exposure to the growing body of science that supported the idea that human activity might impact climate (Weart, 2008). During the 1980's, climate scientists that were convinced of the need to take action began to organize to convince government leaders about the need for policy change to reduce GHG emissions. A variety of institutions brought climate science to bear on the policy process such as the United Nations Environment Program, the World Meteorological Society, and the International Council for Scientific Unions (Weart, 2008), but one has risen to unparalleled prominence in CCC; the Intergovernmental Panel on Climate Change (IPCC).

The IPCC is the world's leading CCC organization and synthesizes climate science, develops consensus scientific opinion about the science, and prepares comprehensive reports called Assessment Reports (AR). In addition to the underlying climate science, the ARs contain scientists' consensus opinion about risks to society from climate change and action that could be taken to mitigate or adapt to the risks. In this process, IPCC scientists practice a linear communication with society on climate change

(Beck, 2011), in which they determine the cause of the problem and possible solutions and communicate this assessment to policy-makers and the public. While IPCC policy requires its communication to be policy-relevant but policy-neutral (IPCC, 2011a), scholars are divided on whether the IPCC is indeed neutral and objective. The IPCC defends its objectivity and neutrality while critics accuse it of partisan behavior in support of a select climate change mitigation regime (Hulme, 2010).

Despite a long established commitment to neutrality, commentaries from the chairman of the IPCC provide examples of partisan behavior and insight as to the intent of the organization that compromise claims of neutrality: In a 2009 newspaper interview, IPCC Chairman, Rajendra Pachauri argued in favor of a variety of select values and policies, such as the heavy taxation of automobile and airline travel, and claimed that western lifestyles were unsustainable (Guardian, 2009). This assessment and prescription is common within the scientific consensus, but it denigrates western societies and has been rejected by them for decades.

Following the 2010 “Climategate” controversy (Bagla, 2010; Jasanoff, 2010; Schiermeier, 2010), the IPCC adopted formal communication policy that applies to all of their communication, verbal and written, establishes that the IPCC Chair speaks for the organization, and requires objectivity, neutrality, transparency, and balance (IPCC, 2011b). Then in December of 2011, Pachauri participated in a video-taped discussion panel with Sir Richard Branson and Governor Jerry Brown of California. During the discussion, Pachauri joked that “those who are becoming obstacles in implementing what is rational should be made the responsibility of Sir Richard to give (a) one-way ticket to outer space. Of course space would be unfortunate to get some of these fellows” (Pachauri, 2011min 55:23). In this quote, Pachauri implied that only the scientific assessment was rational and he ridiculed those he considered obstacles to implementing the science-based recommendations.

More important perhaps, are prepared closing remarks Pachauri made to the Conference of the Parties meeting in Doha, Qatar in November, 2012. Here Pachauri argued that societies should shape their actions on all aspects of climate change, on the basis of the scientific evidence which was more compelling than ever, and he conceded no other knowledge was necessary to meet the challenge of climate change (Pachauri, 2012). At the highest level, IPCC communication reveals support for only one class of policies, criticism for those who disagree, and the expectation that society should simply heed the voice of science. Not only is the behavior of the senior IPCC executive in conflict with official IPCC policy, it is a vestige of the deficit model, a one-way engagement in which society is deficient of the needed scientific knowledge and values.

The IPCC emerged from the growing advocacy of the scientific community for global climate policy and was constituted expressly to provide climate change knowledge to the international policy process (IPCC, 1990b; Weart, 2008). While scholars continue to debate whether it is possible for scientists to provide neutral policy advice, the IPCC has a stated goal of providing policy relevant yet policy neutral assessments. In recognition of Mertonian norms, the IPCC goal of objectivity and neutrality is claimed to maintain IPCC credibility (IPCC, 2011c). However, recall that public audiences lose trust in scientists when they engaged in policy discourse. Policy advocacy by the climate science community is not only common; it may be its distinguishing feature. Yet despite clear policy advocacy from its highest level, the IPCC maintains that some dimension of its communication is neutral and objective. The discordant IPCC parsing of the distinction between neutrality and advocacy is a practical manifestation of the scholarly disagreement about what precisely defines advocacy, along with the theoretical attempt to rationalize advocacy in order to comply with the social norms of science in service of claims to credibility.

Whether or not the IPCC engages in policy advocacy, it has consistently aligned a growing body of scientific evidence largely with only one mitigation regime which compromise its claims to balance[8]. Each IPCC AR has produced growing confidence about the scientific consensus on climate change and the need for mitigation (Christ, 2008), yet public dissent from these expert pronouncements about climate change persists. The imposition on society of ever more science in support of the scientific consensus reveals the premise that the public is deficient in a way that must be remedied with the application of additional scientific knowledge, which is a vestige of the deficit model (Wynne, 2008). Other scholars have expressed similar criticism:

> Supporters of the existing climate regime continue to believe that the problem is one of convincing the opposition about the truth of the science. One reason they believe this is that they can imagine no other policy approach than the one created at the 1992 UN Conference in Rio de Janeiro. After all, the science dictates the policy (Sarewitz, 2011).

Some scholars have proposed alternatives to the consensus scientific assessment by arguing that much of the future climate change risk is associated with population

[8] IPCC policy uses a variety of terms related to non-partisanship; objectivity, neutrality, transparency, balance; none of which they define. In this context balance may refer to equal consideration; which is related to, if not an aspect of, neutrality.

growth, and where people choose to build and live, rather than strictly a result of climate change (Pielke Jr, 2005). Other scholars have raised significant doubts about the consensus mitigation regime which targets a 5 percent reduction in global GHG emissions below 1990 levels. However, atmospheric GHG stabilization alone requires an 85 percent reduction in fossil energy use, suggesting that the consensus mitigation regime is not only insufficient but implausible, and that other solutions, such as atmospheric carbon dioxide scavenging will be required (Broecker, 2010). Climate scientists have been aware of these daunting proportions for thirty years (Broecker, 2013) but have persisted with emissions reduction as the primary climate change solution. Two decades of societies' dissent with this policy idea represent the failure of the climate science community to contemplate critical stakeholder feedback and to consider other knowledge and other value systems. Sarewitz (2011) argued that tying science to only one climate change mitigation plan has damaged the credibility of science. “Meanwhile, and perhaps more dangerously, the cultural legitimacy of science as a source of disinterested, reliable insight into reality has been badly damaged” (Sarewitz, 2011). The term “cultural legitimacy of science” is reminiscent of Wynne’s (2001) assertion that scientific credibility in the public sphere is the credibility that society is willing to invest in science and not what scientists think is credible.

Discussion

Scholarly criticisms of science communication appear true of CCC: scientists tend to privilege scientific knowledge and assume that it is both necessary and sufficient to solve science-based problems for society. In this diagnosis, scientists’ communication with society is linear, and largely assumes that the public is deficient in some way that can be remedied only with the application of additional scientific knowledge. Wynne (1992) claimed that scientists acting in this model do damage to both society and to their own credibility. The literature reveals a growing discourse that is focused on improving science communication, but the practice of CCC remains firmly entrenched in the deficit model – a one-way channel of communication in which climate scientists impose a select assessment and mitigation regime on society, and society's divergence confirms the deficit premise. Wynne's (2006) argument that the deficit model prevailed within the scientific community remains true in CCC:

> What is typically called 'public rejection of science' is properly described as public rejection of commitments based on value commitments that are misunderstood and misrepresented by scientists and policy experts as if solely scientifically determined. The same entrenched cultural assumption gives rise to the deeply problematic habit of describing public issues involving scientific questions as 'scientific issues' (or 'risk issues', and public responses as 'perceptions of risk'). This culture of scientism, or institutionalized idolatry of science, is bound to treat public rejection of those things done in the name of science, as rejection of science, because it has already so falsely narrowed its moral imagination to the idea that support for the policy stance is determined by scientific fact, and that no alternative is left. Thus, some kind of public deficit model explanation of public rejection or mistrust 'of science' is almost preordained as a function of this scientistic, culturally entrenched premise about the basic meaning of the issue at hand (Wynne, 2006b, p. 214).

Wynne (1992) found that Cumbrian sheep farmers were no longer willing to concede the authority of scientific recommendations once it involved the heavy-handed restructuring of their cultural traditions and livelihoods. The mistakes and dismissive arrogance of scientists and authorities, the hegemonic, one-way nature of the communication with and treatment of the farmers, along with the detrimental policies they implemented, led to farmers completely losing trust in science and the British government on the matter:

> However, the dimension of this issue which drew in the farmers, and on which they had the most confidence to judge the outside experts and to criticize them, was the fact that this time, expert responses to the crisis constituted massive interventions, disruptions and denigrations of their normal practices and livelihood. The administrative restrictions introduced by the Government to prevent contaminated lamb from reaching the market were tantamount to large-scale social control and reorganization, and denial of essential aspects of the farmers' social identity, to an extent that the outside experts and bureaucrats did not remotely recognize (Wynne, 1992a, p. 295).

Wynne's analysis forebodes the present practice in CCC. In his 2009 Guardian interview, Pachauri denigrated western lifestyles and proposed interventions designed to control human behavior and achieve a particular solution to climate change. The IPCC chairman's remarks reveal attitudes toward society that are similar to those Wynne (1992) found among the scientists and policy-makers toward Cumbrian sheep farmers, which proved to be damaging to the farmers and to the scientists' credibility. There is sufficient scientific evidence about dangerous climate change to warrant urgent policy discourse but the imposition of the scientific community's assessments and recommendations have steadfastly failed to convince society sufficiently to create momentum for policy action. There is little evidence that the continuation of linear, deficit premised CCC will ultimately convince society to take action.

Conclusion

The attempt of scientists to persuade society is of interest in this dissertation because while scientific knowledge alone may not be sufficient to solve wicked problems like climate change, it is nevertheless critically important. Society may make catastrophically poor decisions without the contribution of scientists and it may yet prove tragic that society has largely not been moved to act to mitigate climate change. Compounding the problem for scientists are the Mertonian norms which discourage scientists from having a personal interest in their research and compel many to rationalize their work as neutral and objective. From their communication and behavior, it is clear that many climate scientists do have a personal interest and would like to see climate mitigation policy enacted, but the social norms of science inhibit their open advocacy for climate policy. This tension is evident when the IPCC chairman openly advocates, while his organization espouses objectivity and neutrality.

Scientific credibility in the public sphere appears to be mediated less by scientific conceptions about it and more by the relationship which science negotiates with society. Although scientific knowledge is important to society, scientific hegemony may be harmful to both society and science. Public distrust of science appears to occur when science communication strays from the facts and ventures into policy discourse: in other words when scientists venture away from neutral and objective information about 'what is' and into discourse about what 'should be'. If this is true, would it be possible to identify purportedly neutral and objective communication that is instead an expression about 'what should be'? Chapter 5 examines selected IPCC reports to identify communication that is submitted as neutral and objective but that is instead an expression about 'what should be'.

CHAPTER 5

CONTENT ANALYSIS OF IPCC REPORTS

> "Yet it is equally clear that knowledge of what *is* does not open the door directly to what *should be"* (Einstein, 1950).

Introduction

Chapter 5 is a content analysis of IPCC reports that looks for purportedly neutral and objective communication about 'what is' that is instead an expression about 'what should be'. Content from the First Assessment Report (FAR) is contrasted with content from the Fifth Assessment Report (AR5); both reports are examined for communication about 'what should be'. Communication about 'what is' is essentially factual, or that which is verifiable in some way and therefore neutral and objective. Communication that deals with 'what should be' will be distinct from factual information by including subjective expressions of value, opinion, and judgment for example. Communication about 'what should be' is of interest in this dissertation because it is a distinguishing feature of sustainability science and CCC.

IPCC intent has long been to provide policy neutral assessments but prior to AR5, the IPCC adopted communication policy that requires neutrality and objectivity (IPCC, 2011a), thus apparently changing the standard to which their communicators would be held. Both FAR and AR5 should be policy neutral but differences between the two might reveal communication considered neutral for FAR that did not meet the new standard established before AR5. The chapter ends by drawing conclusions about the analysis and identifying and discussing its weaknesses.

In 2010, the IPCC suffered a credibility crisis when mistakes were found in AR4 and leaked emails appeared to show that IPCC scientists had acted as partisans in order to advance an agenda (Bagla, 2010; Jasanoff, 2010; Schiermeier, 2010). In response to this credibility crisis, the IPCC adopted formal policy that requires their communication to be objective and neutral in order to assure its credibility (IPCC, 2011c). The new policy codified IPCC's intent to remain neutral; however, the IPCC still intended to provide policy relevant information. An important question is whether scientific information that is policy relevant can be neutral, or conversely whether neutral information can be policy relevant. The Co-Chair of IPCC Working Group Three echoed the latter and expressed frustration with the challenge: “The IPCC has a choice; either it can find a way to present the assessment of climate policies in government-approved summary documents or to run the risk of becoming less policy-relevant” (Edenhofer, 2014).

Methodology

This chapter analyzes IPCC reports in order to identify communication submitted as neutral and objective that may instead comprise some level of communication or persuasion or advocacy about ‘what should be’. Any of the three terms; communication or persuasion or advocacy will suffice as it relates to ‘what should be’ because the word *should* implies persuasion. But for this dissertation I will continue to use scientist advocacy to refer to scientists expressing support for what they think ‘should be’.

Although the literature does not provide a coherent definition for scientist advocacy, one is needed for this exercise but it may be easier to first define what kind of communication is not advocacy and then argue why all other communication represents some level of advocacy. Accused of partisan behavior, the IPCC reified the Mertonian norms of objectivity and neutrality (IPCC, 2011c), and I applied this standard and exempted from advocacy neutral and objective communication. In Merton's context neutral is value-free and objective is factual. In this definition, communication that strays from the facts represented some level of advocacy, as did communication that included the expression of value. This definition may seem expansive unless we take Merton and the IPCC at their word. Furthermore, given that persuasion is a prominent feature of scientist activity relating to sustainability problems such as climate change, scientists might better prepare to persuade should they imagine that they are persuading anytime when they are not truly communicating in an objective and neutral manner. Operational detail for coding the IPCC reports can be found below.

For this research, I analyzed CCC from the IPCC because it represents the consensus scientific view on climate change and it is based on the synthesis of current credible scientific climate research. The IPCC is the globally recognized voice on climate. Other non-government and government organizations, such as the Union of Concerned Scientists, and NASA, produce CCC, but none have dedicated as much effort to synthesize total climate research, none have worked as hard to achieve scientific consensus, and none is more representative of or more recognized as the scientific authority on climate change. Moreover, some U.S. agencies that publish CCC are formally precluded from advocacy, however they may define it.

The IPCC is organized into three Working Groups (WG). WG1 synthesizes the scientific knowledge about climate change, WG2 uses that scientific knowledge to predict the human impacts of climate change, and WG3 considers the work from the other two WGs, and identifies and assesses mitigation and adaptation scenarios for climate change. While based on the science from WG1, WGs 2 and 3 are in total the opinion of the panel about climate change effects and solutions. However, WG1 is the science basis for climate change and the most likely to contain policy relevant but policy neutral information and hence meet the IPCC goal of objectivity and neutrality. The WGs each provide a Summary for Policy Makers (SPM) which is co-authored by the scientists who produced the underlying reports, and government representatives. SPMs are a good choice for this analysis because they are carefully edited in a painstaking process that should result in their meeting IPCC communication standards.

For this research, I examined IPCC WG1 SPMs in the 1990 and 2013 assessment reports because SPMs are targeted to policy makers and are more likely than the underlying reports to be read by the public and policy makers. The balance of this analysis deals with the Summaries for Policy Makers (SPM) for Working Group One (WG1) and compares those documents from the 1990 First Assessment Report (FAR) with those from the fifth assessment report in 2013, (AR5). I will henceforth refer to the 1990 SPM and the 2013 SPM.

I loaded the 1990 and 2013 SPM's into the Qualitative Data Analysis (QDA) software Atlas.ti, and coded the data to apply the definition of scientist advocacy described above and detailed below. Sections that were factual and value free were considered neutral and objective, and not advocacy. Communication that expressed value was coded as advocacy. Expression of value could be explicit or implicit, and could be found in opinion, in judgments, in normative statements, in statements that were linked mitigation policy, or to controversial matters. In controversial matters it is not possible to take a neutral position. I used the following definitions for basic codes:

- *Factual:* Citing facts and adhering to facts. A fact is something that has actually happened, or is actually the case. This would include IPCC uncertainty qualifiers when they truthfully reflect the scientists' level of confidence in the related statement. Facts are verifiable which in science requires repeatability. Examples in this analysis include temperature observations, proven or broadly accepted scientific understandings of the natural world such as the greenhouse effect.
- *Controversial:* Engaging subject matter that is publicly controversial, such as the human attribution to climate change. While there is little doubt in the scientific community that the human use of fossil fuels contributes to global warming, this has been challenged as rationale for supporting climate change mitigation by opponents of the scientific consensus, and it remains controversial. It is not possible to take a neutral position in a controversy.
- *Normative:* Expressing a prescription. For example: "Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions" (IPCC, 2013b, p. 19). Such statements argue for a course of action and are advocacy for it, they are not neutral.
- *Value based:* An expression of the (un)desirability of something. The key defining feature of this code is that these statements are not neutral about the subject and reveal information about the author's values. In IPCC reports the expression of value commonly implies that something is undesirable. For example; ocean acidification bears a negative connotation

that the numerical pH data would not connote, except perhaps to a marine biologist. But IPCC SPMs are targeted to policy makers who may not understand the implications of the pH data but who would likely understand the implication that acidification was undesirable.

- *Opinion:* A belief or way of thinking about something. Some examples include: "The long-lived gases would require immediate reductions in emissions from human activities of over 60% to stabilize their concentrations at today's levels… Carbon dioxide has been responsible for over half the enhanced greenhouse effect in the past, and is likely to remain so in the future " (IPCC, 1990b, p. XI). These statements of opinion are not neutral and align the reports with the scientific consensus on climate change and to advocacy for mitigation.
- *Judgment:* Drawing a conclusion. For example: "Continuation of present day emissions are committing us to increased future concentrations, and the longer emissions continue to increase, the greater would reductions have to be to stabilize at a given level" (IPCC, 1990b, p. XVII). These judgments are not neutral and align with the scientific consensus on climate change and to advocacy for mitigation.
- *Linked to mitigation policy:* Scientific findings and assessments that are linked to the prevailing global policy initiative to reduce greenhouse gas emissions. These statements are not neutral.

Data were coded for all the codes that might apply to a particular passage. For example, a passage could be simultaneously coded as *controversial, normative, value-*

based, opinion, judgment, and *linked to mitigation policy,* but this passage would not likely also be coded as *factual*. However, a passage could be *factual* and *controversial.* I provide examples in my analysis for the application of combinations of codes. In addition, I developed a super-code by querying the data: *Strictly factual* identifies data that is coded *factual* but not assigned any other code.

Analysis: 1990 Summary for Policymakers (SPM), Working Group One

The executive summary of the 1990 SPM begins with a statement that is factual: "There is a natural greenhouse effect which already keeps the Earth warmer than it would otherwise be" (IPCC, 1990b, p. XI). This is an example of a statement that cites and adheres to established scientific fact, is not controversial, does not draw conclusions, does not express an opinion, is not normative, is not value-based, and is not linked to climate change mitigation policy. This passage was coded as *factual* and no other codes were applied, making the passage *strictly factual*, or an example of a neutral statement. Note that this statement is not policy relevant. In contrast, the executive summary cites the report's purpose, which is reproduced below:

> The purpose of the Working Group I report, as determined by the first meeting of IPCC, is to provide a scientific assessment of
>
> 1) The factors which may affect climate change during the next century, especially those which are due to human activity
>
> 2) The responses of the atmosphere - ocean - land - ice system
>
> 3) Current capabilities of modelling global and regional climate changes and their predictability
>
> 4) The past climate record and presently observed climate anomalies

(IPCC, 1990b, p. XIII)

This passage primarily describes an outline for the scientific assessment of climate change. But note that the reference to human attribution introduces policy relevance to the discourse. Recall from earlier chapters that human attribution to climate change has become publicly and politically controversial, as has climate modelling, and the idea that climate scientists are agenda driven. Thus, this passage was coded *controversial*. I applied the view of some scholars that when scientists engage in a controversial issue that a neutral position will not be possible and any communication will align to specific interests in the controversy and become tantamount to advocacy. In this analysis, the passage reveals some level of intent to persuade the audience by suggesting that humans may bear responsibility for climate change, which could justify human action to correct the problem.

Indeed a response by some who are opposed to climate change mitigation has been to deny human attribution and claim that climate change, if any, was due only to natural variability. In addition, the accuracy of climate modeling has been challenged as a basis for scientists' call for climate policy action. Other opponents have accused climate scientists of pursuing an agenda and the appearance of human attribution in the purpose statement of an IPCC report might reveal the presence of a preexisting agenda.

Following a strictly factual first paragraph, the executive summary of the 1990 SPM continues with a statement that is coded as *controversial*, *judgment* (drawing a conclusion), *opinion* (a belief or way of thinking about something), and it is *linked* (through human attribution) *to the need for mitigation policy*. Here it is:

> Emissions resulting from human activities are substantially increasing the atmospheric concentrations of the greenhouse gases carbon dioxide, methane, chlorofluorocarbons (CFCs) and nitrous oxide. These increases will enhance the greenhouse effect, resulting on average in an additional warming of the Earth's surface. (IPCC, 1990b, p. XI).

Although this statement represents the fundamental scientific consensus on climate change, it is not neutral and this assessment continues to be rejected by a significant U.S. population led by prominent opponents to climate policy such as the U.S. Senator from Oklahoma, James Inhofe, who authored the 2012 book: “The Greatest Hoax: How the Global Warming Conspiracy Threatens Your Future” (Inhofe, 2012). Inhofe’s opinion may be regarded by scientists as extreme and not worthy of consideration but this kind of opposition has slowed the development of climate policy in the U.S. The dismissal by scientists of extreme opposing ways of knowing has thus far not eliminated the impact that opposition continues to wield. Neither do all of those in opposition to climate policy deny the related scientific facts about climate change. A majority of Americans believe that global warming is happening, even though there remains resistance to climate policy in the U.S. (PEW, 2014), suggesting that it is not the science that Americans find objectionable as much as the policy recommendations.

I expected to find in the 1990 SPM a high incidence of the code *normative* (expressing a prescription), however, the only code with lower frequency than *normative* with 16, was the super code *strictly factual* with 12. Otherwise, normative language was largely absent in the 1990 SPM. An example of a passage that was coded *normative* involved some form of prescription, in this case specifying a level of GHG emissions reductions: “The long-lived gases would require immediate reductions in emissions from human activities of over 60% to stabilize their concentrations at today's levels, methane would require a 15-20% reduction” (IPCC, 1990b, p. XI). This statement pertains to mitigation targets that are the explicit purview of WG3, but it is based on the science. Nevertheless, the statement is not neutral, it is normative and in this analysis advocates for mitigation.

Some passages were coded as *factual* and also coded as *controversial* because the material adhered to facts but has nevertheless become controversial. The example below cites scientific facts, however the use of paleo climatology has been challenged by opponents who claim that the Earth’s atmospheric carbon dioxide concentrations have been as much as twelve times higher without coinciding with higher temperatures during periods millions of years ago that are not covered by the relatively recent ice-core data cited by the IPCC (Hieb, 2009). Without addressing this contravening argument, the passage below appears to selectively employ scientific evidence in support of a particular interpretation:

> Thirdly, measurements from ice cores going back 160,000 years show that the Earth’s temperature closely paralleled the amount of carbon dioxide and methane in the atmosphere. Although we do not know the details of cause and effect, calculations indicate that changes in these greenhouse gases were part, but not all, of the reason for the large (5 – 7º C) global temperature swings between ice-ages and interglacial periods (IPCC, 1990b, p. XIV).

The 1990 SPM made use of four different future emissions scenarios and I coded this data as *controversial, judgment, linked to mitigation policy, normative,* and *opinion*.

These emissions scenarios, shown in Figure 3 below, are controversial because they infer human attribution. The Business As Usual line represents judgment and opinion. Scenarios B, C, and D, are normative because they prescribe levels of mitigation policy for corresponding reductions (below Business As Usual) in GHG concentrations. Scenarios B, C, and D also emphasize the need for mitigation.

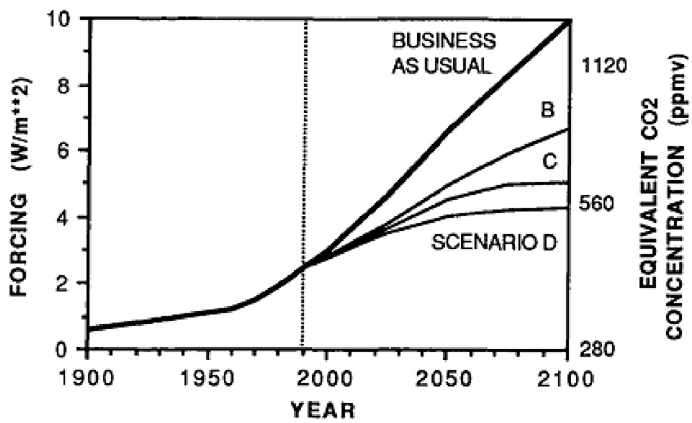

Figure 6: Increase in radiative forcing since the mid-18th century, and predicted to result from the four IPCC emissions scenarios, also expressed as equivalent carbon dioxide concentrations.

Figure 4. IPCC Emissions Scenarios FAR 1990 (IPCC, 1990b, p. XX)

I coded as *value based* any data that characterized the desirability of something. For example, this could be a reference to climate change induced extinction or to the commitment to future sea level rise, which both bear negative connotations that reveal the authors' sense of its undesirability. There may be no way to express these kinds of scientific assessments without entanglement in questions of desirability, which underscores the difficulty of providing policy relevant information that is value-free. Yet these connotations are more contingent upon the values of the authors and the audience, (who may not agree) than on the underlying facts of the matter.

The code frequencies for the 1990 SPM are given in Table 1 and in Chart 1 below. Though WG1 represents the scientific basis for climate change, codes for *judgment* and *opinion* were most frequent, followed by *controversial*. *Factual* and *normative* codes were recorded with the least frequency and there were comparatively moderate frequencies of the codes *linked to mitigation policy* and *value based*. Scientific assessments in this report largely provided indirect references to scientific facts that support the conclusions and opinion. Only nineteen passages were coded as *factual*, of which twelve were *strictly factual*. The 1990 SPM was intended to assess the science of climate change and not necessarily to advise or prescribe policy, and passages coded as *normative* were infrequent. I had expected to find more normative language. I argue that only language that is strictly factual may be considered neutral and objective, which comprised only twelve passages in the 1990 SPM. *Strictly factual* sections totaled 555 words, or three percent of the 14,967 words in the SPM.

Table 1.

Code frequency for 1990 IPCC FAR WG1 SPM

Controversial	Factual	Judgment	Linked to mitigation policy	Normative	Opinion	Strictly Factual	Value based	TOTALS:
84	19	104	49	16	104	12	42	430

Number of passages in the 1990 SPM that were assigned each code. Of the 430 codes assigned, only 12, or 3% of the word count, were considered neutral and objective.

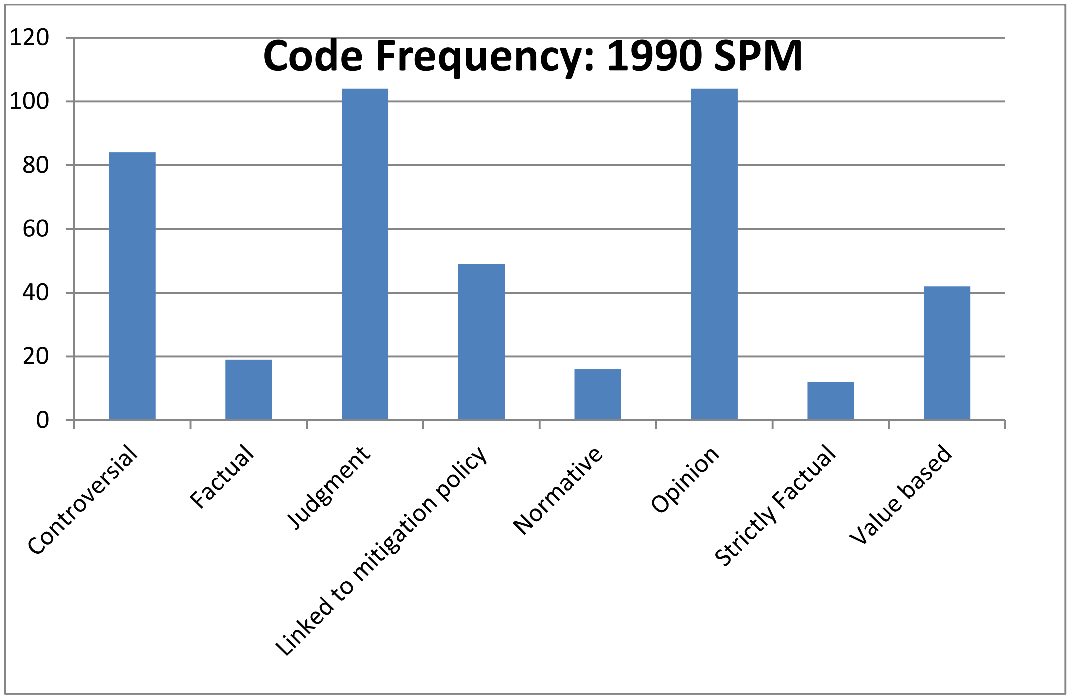

Chart 1. Code Frequencies for 1990 IPCC FAR WG1 SPM

Analysis: 2013 Summary for Policymakers (SPM), Working Group One

The 2013 SPM, was produced under IPCC policy that increased the focus on remaining neutral and objective in order to preserve IPCC credibility. In my analysis of the 2013 SPM, I expected to find adjustments to IPCC communication practices that would reveal their application of this policy. Changes from 1990 to 2013 were expected to reveal communication that IPCC authors believed had not been neutral and objective in the past, while communication that remained unchanged would reveal language that IPCC authors believed was and continued to be neutral and objective.

The 2013 SPM does not provide an executive summary but begins in the introduction with a detailed description of the system employed by the authors to qualify their confidence in the assessments, and each main section of the report begins with an italicized paragraph that describes the scientific methodology that forms the basis for the assessment. Here is the description of the system employed by the authors to qualify their confidence in the assessments:

> The degree of certainty in key findings in this assessment is based on the author teams' evaluations of underlying scientific understanding and is expressed as a qualitative level of confidence (from very low to very high) and, when possible, probabilistically with a quantified likelihood (from exceptionally unlikely to virtually certain). Confidence in the validity of a finding is based on the type, amount, quality, and consistency of evidence (e.g., data, mechanistic understanding, theory, models, expert judgment) and the degree of agreement. Probabilistic estimates of quantified measures of uncertainty in a finding are based on statistical analysis of observations or model results, or both, and expert judgment. Where appropriate, findings are also formulated as statements of fact without using uncertainty qualifiers. (IPCC, 2013b, p. 4).

While references in the 1990 SPM to the scientific basis for the assessments were indirect, the system used in the 2013 SPM provides more precision with which to qualify the strength of the assessments. Note from the last sentence in the quote above that the IPCC has made a distinction between qualified assessments and what they believe to be fact, which they would state without uncertainty qualifiers. It is a significant change from 1990 that the IPCC chose to specifically distinguish factual information, and to qualify their confidence in other key findings that are not factual. Indeed, the most dramatic change from 1990 was the increase in codes for factual information.

The 1990 SPM opened with a short statement that was coded *factual* but the second paragraph was coded as *controversial, judgment, opinion,* and *linked to mitigation policy*. In contrast the introduction of the 2013 SPM is clear and precise and I coded it *strictly factual*. Section B of the 2013 SPM recounts the observed changes in the climate system along with related assessments, and begins with the italicized paragraph, described above, that outlines the scientific methodology that forms the basis of the assessment. In contrast to the 1990 SPM, the description of methodology provides a clear and concise foundation for the factual observations about climate that follow, and it is reproduced here:

> Observations of the climate system are based on direct measurements and remote sensing from satellites and other platforms. Global-scale observations from the instrumental era began in the mid-19th century for temperature and other variables, with more comprehensive and diverse sets of observations available for the period 1950 onwards. Paleoclimate reconstructions extend some records back hundreds to millions of years. Together, they provide a comprehensive view of the variability and long-term changes in the atmosphere, the ocean, the cryosphere, and the land surface (IPCC, 2013b, p. 4).

Each major section of the 2013 SPM begins with conclusive assessments about the material that follows and, as in the 1990 SPM, assessments in the 2013 SPM involved judgment and opinion, and they were often value laden and controversial. While the observations on the climate are factual, the conclusions that lead from them do not adhere solely to facts. Here is the overall assessment leading into the 2013 SPM Section B on observations about Earth's climate:

> Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased. Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. In the Northern Hemisphere, 1983–2012 was likely the warmest 30-year period of the last 1400 years (*medium confidence*) (IPCC, 2013b, pp. 4-5).

This passage contains four sentences. The first sentence is stated as fact, with no uncertainty qualifier. But the statement was coded *controversial* because the subject is warming of the climate system and it suggests that warming since 1950 is unprecedented for millennia. A challenge to the scientific consensus on climate change that has gained traction with the public, claims that the Earth has been harmlessly warmer than the present for 9,000 of the last 10,000 years (Monckton, 2011). The characterization of unprecedented change was coded *value based* because it implies undesirability. The sentence was coded *judgment* because it draws a conclusion and *opinion* because it reveals a way of thinking about the Earth's climate. The last sentence was likewise coded *controversial, judgment, opinion,* and *value laden,* but note how the authors qualified this statement as "medium confidence" thus conceding that the statement was not factual and that it was rather something they believed with medium confidence. In other words, the authors conceded that the last sentence was opinion, which is itself a form of honesty or adherence to fact and may improve the credibility of the report. In contrast, the second and third sentences of the passage are examples of strictly factual language that is objective and neutral. Claims that the atmosphere and oceans have warmed are factual. The third sentence has a similar meaning to the first sentence, but instead of using adjectives like *unequivocal* and *unprecedented*, the sentence was worded to be factual. However factual they may be, the second and third sentences are also not policy relevant because they simply recount climate related observations.

Section B, on observed changes to the climate system, continues through page 12 of the 2013 SPM and covers the atmosphere, ocean, cryosphere, sea level, and carbon and biogeochemical cycles. It includes a great deal of strictly factual observations worded like sentences two and three above, but interspersed with assessments that are variously *controversial, opinion, judgment, value laden, normative,* or *linked to mitigation policy*. Some of this material is fact–based and yet controversial and value laden. For example, Figure 4 below shows IPCC charts representing warming observations from the past and yet the material is controversial. Critically, the narrow time frame chosen for this chart does not cover the framing of decades to millennia used in the conclusive lead-in assessment to this section, thus overstating the observed temperature increases. The selective uses of time frames to produce charts with sharp temperature increases have become controversial (McLaughlin, 2009). “Hockey stick” temperature charts have become so controversial that that climate scientist Michael Mann, who may be most associated with the idea, has endured substantial public abuse and even death threats for purportedly manipulating data for dramatic effect (McKie, 2012). Whether or not this is true, for many people the inconsistent application of analytical time frames appears to be the selective use of data for effect and it is controversial and has the appearance of the attempt to persuade. In the bottom figure, the authors could have chosen any color scheme to represent the global distribution of observed temperature increases but the colors of glowing embers have been deliberately chosen in other IPCC reporting to persuade the audience of risk or danger (Mahoney, 2012).

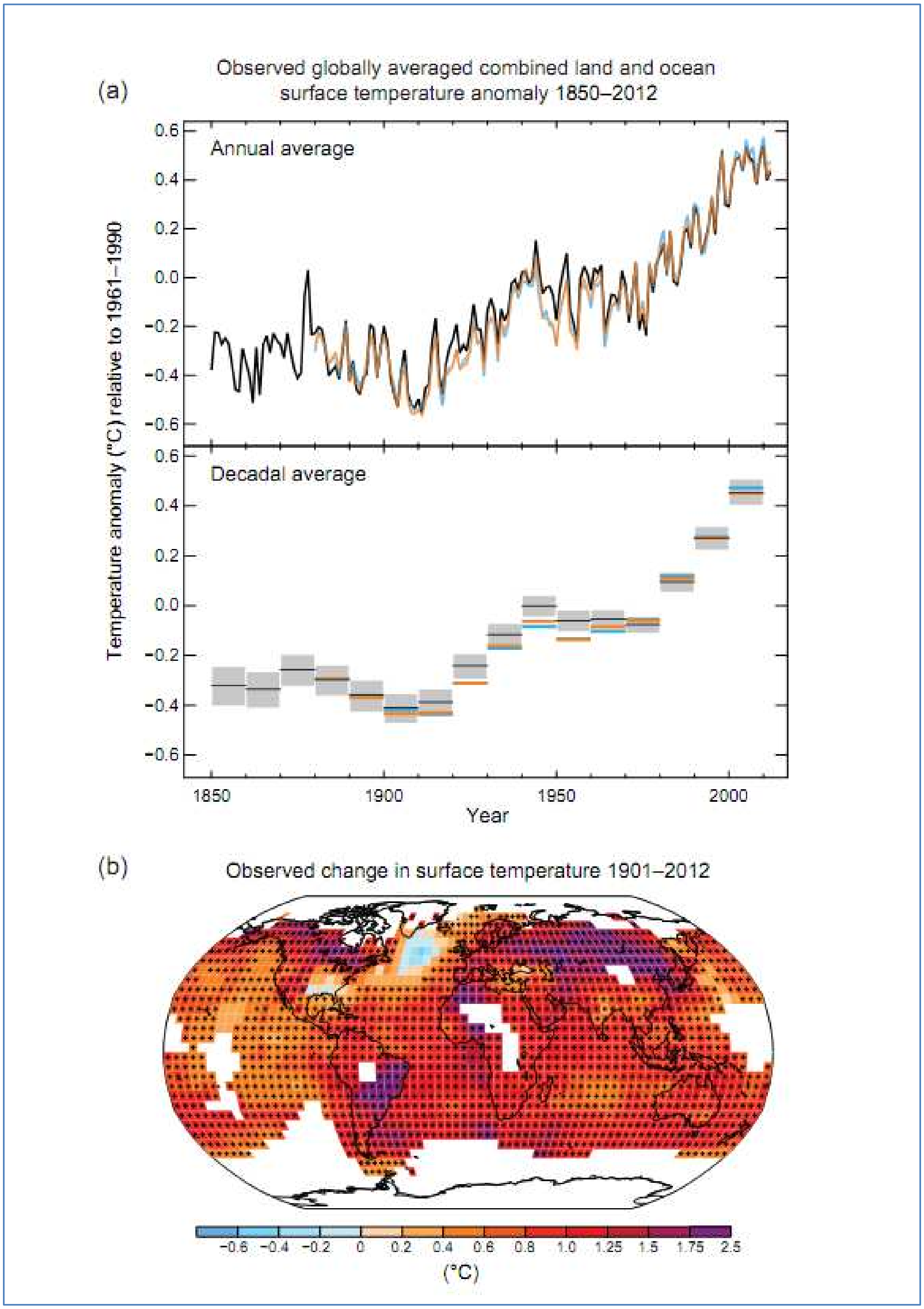

Figure 5. IPCC Observed Temperature Changes (IPCC, 2013b, p. 6).

The code frequency of the 2013 SPM compared to the 1990 SPM is given in Table 2 and plotted in Chart 2. Plausibly due to the continuing research since 1990, the 2013 SPM contains a great deal more factual information. While individual statements in the 1990 SPM frequently combined indirect references to scientific fact to support a conclusion, the 2013 SPM contained more statements that appeared to be carefully worded to be strictly factual and entirely separated from assessments, that might be *judgment, opinion, controversial, normative,* etc. Indeed, the frequency of *factual* and *strictly factual* codes in the 2013 SPM both increased three-fold over the 1990 report, representing a dramatic increase in the authors' emphasis on directly referencing factual information. In contrast to 1990, the 2013 SPM contained marginally fewer passages that were *judgment,* or *opinion,* but these remained the two most common of all codes for both reports.

In contrast to 1990, the 2013 SPM contained a significant increase in *value based* statements suggesting that the authors perceived the expression of judgment, opinion, and values as complying with new IPCC policy that required its communication to be neutral and objective. *Value based* coding is commonly related to climate change impacts such as sea level rise, and the observed 2013 increase in code frequency could be the result of additional research producing growing evidence about climate change, but the authors would nevertheless have had to reconcile their communication with the new IPCC policy. Given the policy requiring objectivity and neutrality, the presence of *value based* (non-neutral) communication in the 2013 report is more significant than the change.

In contrast to 1990, the 2013 SPM contained a similar proportion of codes *linked to mitigation policy* but the change is less significant than the continuing presence of policy related statements in a document ostensibly focused on science. The 2013 SPM contained an increase in controversial statements and the frequency of controversial statements remained high but the incidence of controversy may be beyond the sole purview of the authors, and mediated more by the prevailing political environment. As with the 1990 SPM, the 2013 SPM contained very little normative language and in 2013 sections coded *normative* had dropped by nearly half to become the lowest frequency code.

Table 2.

Code Frequency for 1990 and 2013 SPM WG1

	Contr.	Factual	Judge.	Linked to mitigation policy	Norm.	Opinion	Strictly Factual	Value based	TOTAL
1990 SPM	84	19	104	49	16	104	12	42	430
2013 SPM	95	66	94	52	9	92	43	62	513

Code frequency for the 1990 SPM and the 2013 SPM for WG1.

The most dramatic change in communication practice from the 1990 SPM to the 2013 SPM is the increase in factual statements. The IPCC intent to remain policy relevant may explain the continuing high frequency of *judgment* and *opinion* in the 2013 SPM, along with the growth in value laden language. Given the presence of IPCC policy requiring objectivity and neutrality, it is noteworthy that the three highest frequency codes in 2013 remained *judgment, opinion,* and *controversial,* which, in carefully prepared documents, implies that the IPCC believes this type of language complies with their policy.

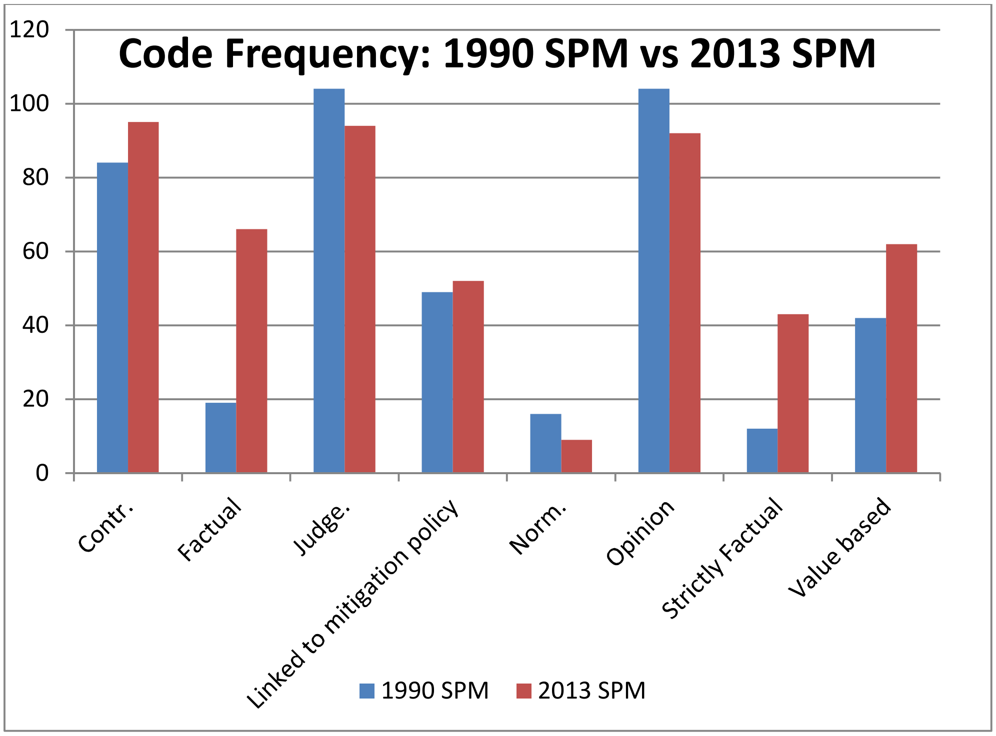

Chart 2. Code frequencies for the 1990 SPM compared to the 2013 SPM for WG1.

The communication patterns reflected in the 1990 and 2013 SPM's support the idea that policy relevance requires more than strictly the facts of the matter, and demands commentary on the meaning of the facts, which requires the application of values, judgment, and opinion. Despite the presence of IPCC communication policy that required objectivity and neutrality, the bulk of the 2013 SPM contained language that was not objective and neutral and could be considered some level of advocacy, or intent to persuade as revealed in subjective expressions of judgments, opinions, and values.

Conclusion

There is unresolved tension between the idea of being policy relevant and the idea of remaining policy neutral. Statements that adhere to the facts may enhance objectivity and neutrality, but statements without values, judgment, and opinion may not be policy relevant. Consider the following passage from the 2013 SPM:

> The globally averaged combined land and ocean surface temperature data as calculated by a linear trend, show a warming of 0.85 [0.65 to 1.06] °C, over the period 1880 to 2012, when multiple independently produced datasets exist. The total increase between the average of the 1850–1900 period and the 2003–2012 period is 0.78 [0.72 to 0.85] °C, based on the single longest dataset available (IPCC, 2013b, p. 5).

This statement is *strictly factual*; it simply conveys that certain datasets indicate that the Earth has warmed by a certain amount over a certain period. The statement does not indicate why the planet is warming, it does not indicate whether or not the warming is desirable, and it does not indicate whether or not anything should be done about the warming. The statement provides no information about policy, it is policy neutral. The problem for scientists who wish to influence policy matters is that facts alone can only state 'what is' and not 'what should be'. Scientists who wish to derive meaning from facts are forced to negotiate facts and values and this necessarily involves their values, and those of other stakeholders, influencers and decision makers whose cooperation is required to advance policy. The negotiation of facts and values involves the attempt to persuade, or to advocate on some level, which will be revealed in the non-factual and non-neutral representations of the stakeholders thus negotiating. I argue that in IPCC SPM's advocacy manifests in the author's normative statements, judgments, statements of opinion, value based statements, in statements that are aligned to prevailing policy proposals; and statements that align the authors within a controversy; essentially everything that is not both factual and neutral. Despite the presence of IPCC communication policy that requires objectivity and neutrality, my analysis indicates that the bulk of the 1990 and 2013 SPMs for WG1 contained some level of advocacy.

Authors of the 1990 and 2013 SPMs either believed that their work remained neutral and objective or they perceived no other option for achieving policy relevance, which suggests that it is not possible to produce policy relevant communication that is also policy neutral. In policy relevant discourse, the facts will quickly be colored with the values, opinions, conclusions, and normative frameworks of the stakeholders, a process from which scientists are not exempt, regardless of their claims to neutrality and objectivity.

I do not propose that scientists do not make claims about the meaning of scientific fact, quite the reverse; scientists must assert their expertise or society may make catastrophic decisions. However, I do argue that scientists recognize the truth in Einstein's words; "that knowledge of what *is* does not open the door directly to what *should be"* (Einstein, 1950). As such, I argue that scientists recognize when their communication ceases to be neutral and objective, and that they develop skills to negotiate facts and values more effectively. This is the crux of the challenge for climate scientists and sustainability scientists; they must find a way to negotiate facts and values or risk becoming less policy relevant (Edenhofer, 2014). Conversely, scientists cannot make policy relevant assessments without engaging in some level of advocacy (Sarewitz, 2012). It seems prudent that scientists engaged in policy, and sustainability scientists generally, develop skills of persuasion and negotiation for the likelihood that stakeholder engagement in service of problem solving will involve scientist advocacy.

A weakness of this analysis relates to subjectivity in the coding scheme. For example, it cannot be asserted unequivocally that a statement is *value based;* the decision involves a matter of some judgment, and another researcher may code differently and arrive at significantly different numbers. However, the value in this analysis is found more in the phenomena than the numbers and I do not believe numeric differences would invalidate the conclusions of this analysis unless a researcher were to use entirely different definitions for neutral and objective, which is plausible due to the range of opinion about advocacy visible in the academy. In carefully crafted reports that are purportedly neutral and objective, the substantial presence of non-neutral and non-objective communication is meaningful. Furthermore, questions about coding precision quickly become an extension of the intractable debate in the academy about scientist advocacy. There does not appear to be a solution in sight, and rather than engage the advocacy debate, I propose the novel approach of assuming that one is advocating whenever one strays from strictly neutral and objective communication. Finally, dismissal of these conclusions would not obviate the need for scholars and scientists to deal the problems identified in this research. Challenges with scientist advocacy and the normative dimension of sustainability are important and I welcome the idea of subsequent investigations and that they might employ more robust methodology.

This chapter has examined the plausible manifestation of scientist advocacy in IPCC communication, but without the communicator's input on the subject. Chapter 6 continues the discussion of scientist advocacy with structured interviews of scientists and non-scientists who were professionally engaged in climate change communication.

CHAPTER 6

STRUCTURED INTERVIEWS WITH PROFESSIONALS ENGAGED IN CLIMATE CHANGE COMMUNICATION

Introduction

Chapter 6 analyzes structured interviews[9] with scientists and non-scientists who were professionally engaged in Climate Change Communication (CCC). The purpose of this research is to observe how the views of these professional climate science communicators compared with the scholarly views found in the first three chapters and with the IPCC analysis in Chapter 5. My primary interest remains the normative dimension of sustainability communication as manifested in climate science, and this research has steadily focused on the challenges of scientist advocacy and its conflict with objectivity and neutrality. Following a description of the methodology for this research, the chapter explores the interviewees' opinions about scientist advocacy, scientific credibility, and targeted audiences. Each section first analyzes the views of scientists, followed by non-scientists, and closes with commentary about the subject, contrasting the views of the two groups. The chapter concludes with commentary on this interview research and synthesizes it with the earlier chapters.

Methodology

I conducted twenty one structured interviews with scientists and non-scientists, who were all professionally engaged in CCC. The subject group was a convenience

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[9] I found these interviews interesting and informative and I am deeply grateful for each person's cooperation and for their openness. Evident with every interviewee was a deep caring for humanity and the environment, and a sincere desire to contribute in a positive way to the struggle to solve the climate change problem. My remarks in this chapter are in no way critical of individuals and rather seek to understand their views on CCC, and the tension between advocacy and the social norms of science.

sample. Eighteen subjects were recruited at the American Geophysical Union Chapman Conference *Communicating Climate Science: A Historic Look to the Future*, in June of 2013, and three subjects were otherwise known to me. Outside of the interviews, no subjects were associated with or had any interest in my research. Nine subjects were natural scientists, who in the course of their work on climate change had become active in CCC. The remaining twelve subjects were non-scientists, with professional training in disciplines other than climate science, which included writing, communication, video production, public relations, weather forecasting, web-design, blogging, and journalism.

Materials and Procedure[10]

The Institutional Review Board (IRB) at Arizona State University granted approval for this Human Subjects research. The interviews were in the form of structured questionnaires, with open-ended questions, and all interviewees were asked the same questions. All were adults; their participation in - and my recording of - the interviews was voluntary, and, although none did, they could have stopped the sessions at any time if for any reason they were uncomfortable. The interview questions[i] were non-controversial and all interviewees were offered copies of the IRB approval and information letter[ii] that outlined the research and provided contact information for my research supervisor and the IRB at Arizona State University. The identity of the subjects will be kept confidential, the original recordings and transcripts have been destroyed, and effort taken to not reveal through the quotations, or by my characterizations, the identity of any subject. In this effort, some inconsequential details in the quotations have been omitted or changed to generalities.

[10] IRB documents, interview questions, and coding structures are reproduced in the Appendixes.

The interviews totaled 469 minutes and most lasted about 25 minutes. Some subjects were less talkative and progressed through the questions in as little as fifteen minutes, while one or two lasted nearly an hour. All interviews were transcribed into Microsoft Word documents and corrected to the original digital recordings for accuracy. Punctuation was based on context and inflection, in order to best convey the intended meaning which in most cases was clear. The data were read and marked for key themes and to develop conceptual ideas for coding. The documents were then saved in rich-text format and loaded into the ATLAS.ti Qualitative Data Analysis (QDA) program which enables a systematic coding of the data and facilitates the retrieval, querying, and analysis.

The data were coded in two cycles using methodology described in (Friese, 2012). In the first cycle, primarily descriptive codes were developed while processing roughly a third of the data. At this point, the original descriptive codes were structured into a hierarchical and more conceptual scheme and the documents were recoded in this scheme of about sixty codes. With the exception of introductory or tangential remarks, all of the interviews were coded in their entirety and the majority of the dialogue was analyzed. In the qualitative analysis, the code structure was again reviewed, and many codes with only one or two quotes were reconsidered, and either reassigned or eliminated. All codes were organized into seven code families to reflect the interviewees' responses regarding (in alphabetical order): advocacy, audience, challenges of climate science, climate change communication, interviewee background, media, and science. Each of these code families[iii] comprises several sub-codes. The data in each code were then examined to highlight descriptive characteristics about the interviewees and their views, and to develop the more conceptual analyses and comparisons revealed in the interviewees' perspectives.

Opinions on Advocacy in CCC

How scientists discussed advocacy. Scientists freely revealed their support for climate policy and a motivation to solve climate change, to save the earth, to influence society and to take action to mitigate climate change. They recognized that there was a difference between communicating empirical findings such as the fact that the Earth was warming, and communicating recommendations about what society should do about global warming. Some scientists thought that they should be honest with their audience when giving their opinion about policy and thought that avoiding advocacy was important. But there was a wide variation among the scientists' views about how to discuss policy or recommendations for action, and when that activity might be considered advocacy. Many scientists thought that it would be unethical to have gained the technical understanding of climate change and not warn society about the danger. For example:

> And in my mind, and that's I guess where my morals are, if we knew something and we didn't tell you, didn't tell the rest of us who can't see it, it is a form of negligence, it is a form of, I guess, cheating (P21 S 79)[11].

Most scientists held a negative connotation of some sort about advocacy and tended to avoid it, but they also blurred the distinction between warning society (risk assessment) about danger and advocating action to mitigate that danger (risk

[11] To keep the identities of all interviewees confidential they are referred to in the following manner P21 refers to the primary document number (or interview transcript), S indicates that the interviewee is a scientist (NS for non-scientist), and 79 refers to the paragraph in the document where the quotation is located.

management). In the process of answering questions about objectivity and neutrality, the scientists expressed a variety of nuanced views about the definition and appropriateness of advocacy. Here scientist P18 made a distinction between their scientific work and advocacy but described their own advocacy without hesitation or prejudice. But they would later eschew advocacy.

> (I was researching) a high resolution coastal (glacial) core. And that's when I think I became very involved in the disconnect - was very intrigued by the disconnect - between the science that we knew then, which was pretty robust, and the lack of policy. And so I've been flitting between Antarctic science and advocacy ever since, largely through an incredible passion for Antarctica, a passion for the planet (P18 S 17).

Scientists' conceptions of advocacy were often related to their ideas about whether or not it was acceptable behavior. Most scientists felt compelled to warn society about climate change and call for action to mitigate, but in doing so to somehow avoid the mantle of the advocate. Many revealed an aversion to advocacy and defined it in terms that excluded their own behavior. Here scientist P18, who had readily admitted to advocacy above, thought that scientists should discuss policy solutions more willingly but then explained how just calling for mitigation would not be policy prescriptive, that it would not be advocacy:

> I think that it's an easy out for particularly climate scientists to say well, here's the science and I'm not going to comment on the policy because I'm not an expert in that area. And I think it's much simpler than that: because I'm a climate scientist, I know what the risks are. I know what's happening. I can still say we

> need to mitigate. That's not being policy prescriptive, that's just stating what I think for most climate scientists is an obvious fact. There wasn't anyone on the panel today who had any trouble saying mitigation has to happen, so I think it's tough to call that advocacy. I think advocacy is when you're being really very policy prescriptive (P18 S 69).

Below, scientist P21 thought they had an obligation to perform a risk assessment role for society but it seemed important for them to establish in the same breath that just warning society about problems was not advocacy:

> You know, I mean, I'm using tax dollars to do my research. I am, you know, in a position to teach, or whatever, other folks. I see it as my obligation to society to perform this particular function of being part of the immune system that detects that there's something wrong here. So, you know, I don't think that, in and of itself, is advocacy (P21 S 79).

However scientist P21 had earlier characterized the desired climate change engagement with society as an intervention: "I think we might actually get enough people in the right places to set in motion the large scale interventions" (P21 S 63). On the one hand they endorsed intervening, which is more partisan than simply warning society, and on the other hand they distanced themselves from advocacy, and they seemed unaware of the contradiction. As in the above examples, scientists commonly demonstrated an aversion to advocacy accompanied with reasoning that certain behavior was not advocacy. It is noteworthy that scientists' expressions eschewing or rationalizing advocacy occurred in conversation dealing specifically with scientist advocacy. Scientists who had revealed support for interventions or advocacy offered rationalizations absolving their behavior of advocacy when questioned directly about objectivity and neutrality. It was when the context of the conversation involved the social norms of science that negative connotations about advocacy and related rationalizations emerged.

Many scientists described their role as providing scientific information to their audiences and they expected an informed audience would advance climate policy. Tension was evident between scientists' self-image as solely knowledge providers, and their desire to see climate policy enacted. Most scientists argued for their preferred policy action but then avoided characterizing their intent to persuade as advocacy, and rather continued to describe their roles as providing information: "I mean, we don't - we don't really discuss solutions, we just discuss science issues" (P13 S 93). However, their desire to change minds was sometimes evident even while discounting their intentions:

> My primary goal is to get people to be thinking differently on what they've locked themselves into thinking. My goal isn't to convince them that everything that they believed up until now is wrong and I'm right, and like a pied piper they should follow me around, it's to get them to thinking, open up their eyes and ask them to actually question their own beliefs (P16 S 41).

How non-scientists discussed advocacy. As with the scientists, the non-scientists all supported climate policy action and most explained that they or their organizations did not recommend policies or tell people what to do. The non-scientists seemed more direct if not casual about eschewing advocacy, often stating it in a matter-of-fact manner along with a quick, perhaps practiced explanation. In contrast with scientists, non-scientists were not as encumbered with negative connotations nor were they as defensive about advocacy and they often did not use the term at all. The following quote from a consultant is reminiscent of the deficit model by implying that the addition of knowledge about climate change would result in more intelligent choices, but they did not prescribe action:

> We try to not tell anyone what to do, but to provide them enough information - we have this opening statement we make pretty much when we talk to anybody by saying our goal is to increase your ability to engage in a reasoned discourse about climate change. And when you have that ability, then you can make more intelligent choices about what you do. So we're not telling anyone what to do (P8 NS 109).

The following non-scientist described how their organization defined advocacy as direct support for specific legislation. They claimed that careful phrasing would permit them to discuss mitigation without advocating for a specific policy. While their recommended phrasing does not unequivocally prescribe mitigation, it is positively aligned to it as opposed to the reverse. The logic below is similar to that employed by the IPCC in the use of 'if – then' statements that are linguistically structured to be neutral. It is notable that although P20 was not a climate scientist, they represented a scientific organization. The quote bears characteristics of the deficit model:

> I mean, at (my organization), traditionally more scientists have discussed, (or) focus on the science and then, in terms of advocacy, they've phrased *if – then* statements. For example: 'if we want to reduce the effect of climate change, then it would behoove us to reduce our CO_2 emissions', and that's typically as far as (our) scientists go in their statements. They don't typically prescribe: 'we need to pass X bill' or whatever. And certainly, in my writings, I've been out in the same vein, you know. I tend to be more of an explainer and a perspective setter and I

> like to think that simply, you know, helping people to become better informed and doing what I can do in that realm would then help them to make informed decisions and choices (P20 NS 71).

In the next quote, non-scientist P3 claimed to avoid advocacy and directly aligned their organization's views with the IPCC, specifically that climate change was happening and that it was human induced. However, the IPCC not only holds that climate change is human induced but that mitigation is necessary if we wish to avoid the direst consequences of climate change. By aligning to the IPCC, they are also aligned with the prevailing mitigation regime. P3 also represented a scientific organization:

> If we were asked about climate change, I would cite the IPCC report. I would say our scientists concur with, you know, the majority of the scientists as represented in the IPCC report, that climate change is happening and its human induced. But, we don't recommend policies (P3 NS 127)

While most of the non-scientists used simple terms and logic, some offered more complicated explanations to explain their stance on advocacy. The logic in the next quote is convoluted, but seems to argue that they can act like advocates without truly advocating. The quote bears characteristics of the academic struggle with advocacy, although rationalizing about advocacy was uncommon among the non-scientists who mostly eschewed it in simple terms.

> Or just even saying a fifty percent clean energy renewable standard in the United States, you know [...] We're merely, you know – we're not advocating in the strict sense of being an advocate, in terms of advocating a particular policy. No, we're not an advocate. In the sense that maybe we're advocacy actors or political actors

> in that we're trying to generate public will for actual climate change, we are. There's a distinction in there. Maybe it's worth highlighting because, you know, we don't talk to people, we don't – we never suggest or advocate policies in any of our communications (P2 NS 113).

Non-scientist P11 below argued in favor of scientists providing policy advice unless ideologically motivated, however they offered no rationale for identifying when subjectivity might enter the discourse:

> But I just think that, you know, people think advocacy - or scientists have begun to describe advocacy as being, as if it was a problem. But advocacy is just simply advising on a way forward, right? The issue here is about advocating policies based on the evidence and a clear set of policy objectives, rather than on an ideological stance and that's the separation (P11 NS 161).

Normative Views on Advocacy in CCC

Scientists largely thought the scientists should not advocate. However, they also offered a variety of reasoning to explain why their behavior was not advocacy. Similar to the views expressed in the literature on scientist advocacy, there was no consensus regarding what scientist advocacy was or whether or not scientists should advocate. One scientist declared simply: "I don't want to prescribe to them how they should think about things" (P19 S 21). Similar to views found in the literature, some scientists thought that science and advocacy were distinct activities: "You know, when the leader of this conference gets up and says 'we're right and we've got to get the word out,' you know, I mean, okay, there's something non-scientific about that" (P12 S 281).

Scientist P19 recounted a common academic argument against scientist advocacy that is grounded in the social norms of science:

> Once you start advocating, you've essentially already given up your objectivity. So you - and you need to be open. If you're not objective about what you're getting - what - you want to follow the data. You don't want to follow where you think the data should take you or where you expect the data to take you. You need to be able to be surprised and go back and reassess and go oh, okay, well now I've learned something new and I'll move on. Again, somehow when you start doing advocacy, you kind of dig in and entrench yourself in a viewpoint and I don't think that's - that's not where I want to be. I don't think that's appropriate (P19 S 45).

While scientist P19 above mentioned losing scientific objectivity, references by other interviewees to the social norms of science were largely vague or dismissive, for example: "I think it's one of the grand illusions of science that, you know, especially natural science, that they're somehow value free or something like that" (P21 S 85). Others revealed that advocacy was not allowed in their organization: "So we were set up to provide science to the people who make the policy. But it was kind of made clear that (advocacy) wasn't our role and the university doesn't want us in that role either. And we, I don't feel comfortable acting in that role" (P17 S 69). Nevertheless, there was an evident belief, mainly among most scientists, that advocacy; however they defined it, was not appropriate scientist behavior.

Non-Scientists largely thought that scientists should advocate more. Many of the non-scientists I interviewed thought that scientists should be vocal about not only what the science indicated were the threats of climate change, but also about what they thought societies should do to mitigate that threat. A filmmaker encouraged scientists to be active in the climate change debate and dismissed the idea that scientists' credibility would be damaged if they were too vocal:

> Scientists' credibility remains high. Every poll shows that they are among the most trusted sources for the general public. So I don't think - I mean, you can argue that maybe certain scientists carry a little bit of baggage due to the high visibility or controversial past or whatever, but scientists in general have not suffered from becoming more visible on this and I think that there's a general recognition that they need to do more of that (P7 NS 59).

Other non-scientists expressed clear support for scientists becoming more involved in the dialogue about solutions to climate change, with many claiming that scientists had a moral obligation to not only warn society about the threat but to also recommend solutions. P10 characterized this moral aspect as follows:

> You might just say, well, 'that person's about to shoot that other person. Isn't that intellectually interesting? You know, and I don't want to interfere in that because I need to stay objective and I'm not going to do that,' you know. I think if you see somebody about to shoot somebody else, you ought to probably at least call 911, if not, leap on the gunman (P10 NS 90).

Some scholars have argued that scientists should avoid advocacy in order to preserve their credibility, however the following non-scientist argued that scientists damaged their credibility by avoiding advocacy, if they proclaimed the danger of climate change and then had no opinion about what society should do to deal with the danger.

However, they also conceded that scientists should be honest about what was not within their area of expertise. The full quote is salient:

> There's one other aspect of the debate which I have even more difficulty getting across to scientists is that when they talk to politicians or the public and they explain the scale of the problem, they'll be facing the risks that we face, and then the natural response from any sane person is: 'oh, my God, what shall we do?' And then the scientists say: 'well, I'm sorry, that's not my area of expertise. I can't tell you.' Not only is that incredibly unhelpful, but it actually sends a message to the person well, if you really believed what you just told me, you would have found out what you thought we might do. You wouldn't have just expressed no view on it. It's like saying: 'well, I think the house is on fire.' 'Well, what should we do about it?' 'Well, I don't know, ask somebody who knows about how to deal with fire' (P11 NS 141).
>
> I've had these arguments with, in particular, Richard Pielke, Jr., who has a particular view on this… which is essentially scientists should, you know, be of course honest brokers, that they have no other place. I don't buy that. I mean, I just don't. I think it's asking scientists to behave in an - not behave as citizens. I mean, they have to be clear about what is their area of expertise and what is not (P11 NS 155).

P11's perspective in paragraph 155 is reminiscent of some scholar's arguments that no behavioral norm of science should require scientists to waive their rights as citizens to advocate for the change that they believe is necessary. Many non-scientists thought that scientists should not be precluded from advocating, that it was their right as citizens to be involved. Others thought that scientists had a moral obligation to not only warn society of risks like climate change but to advocate for changes that would reduce those risks.

Commentary re: Opinions on Advocacy in CCC

My interviewees all understood that advocacy fundamentally entailed some form of support for a particular outcome. However, as with scholarly perspectives on scientist advocacy, my interviewees showed no consistent agreement as to what specific behavior comprised scientist advocacy or whether scientists should or should not advocate. Their views were often contradictory, some were convoluted, and overall they offered no coherent position. All of the interviewees revealed a support for climate policy action, but most reasoned or simply claimed that they did not advocate. Remarkably though, many of the non-scientists thought that scientists should advocate. The scientists' objection to advocacy was loosely grounded in the social norms of science, and scientists seemed motivated to preserve their credibility by reasoning that their behavior was not advocacy, thus preserving their objectivity and neutrality. Some scientists expressed frustration with the encumbrance of the social norms of science, and yet reified them by explaining that they did not advocate.

Chart 4 shows a pronounced difference between the views of scientists and non-scientists about scientist advocacy. Although most non-scientists denied advocating themselves, the majority of non-scientists supported scientists becoming more active advocates. The majority of scientists thought that scientists should not advocate.

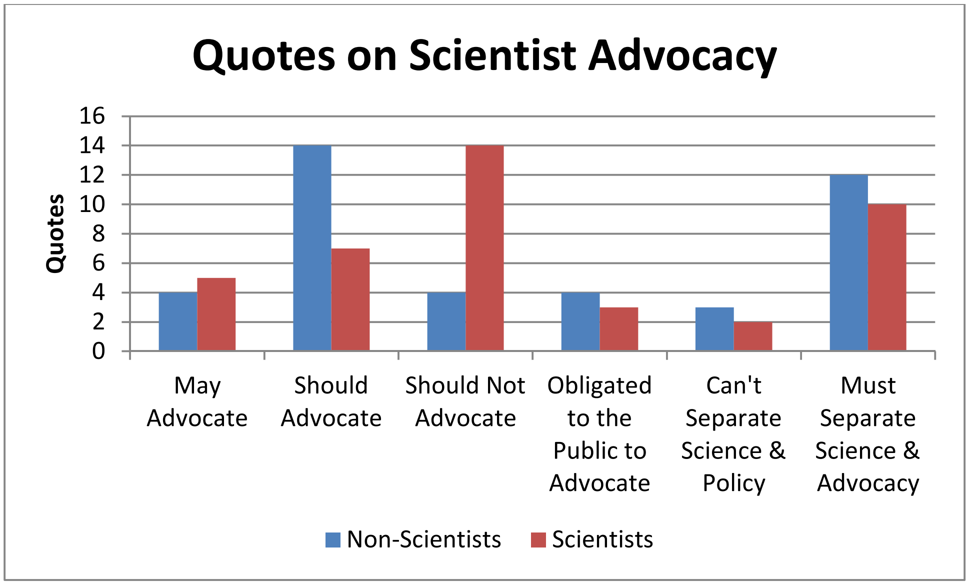

Chart 3. Number of quotes on advocacy comparing scientists and non-scientists. Non-scientists favored scientist advocacy while scientists did not.

There was no marked difference between scientists and non-scientists among the other codes in the chart. Both groups largely agreed that science and advocacy should somehow be kept separate. The following quotes are exemplary: "I think it's conceivable for scientists to be advocates, but maybe not simultaneously" (P20 NS 85). "…and maybe they might say, okay, I'm putting on a different hat now. I'm speaking as a concerned citizen who happens to know about soil science or whatever" (P5 NS 121).

Opinions on Credibility in CCC

Scientists held a variety of views on credibility. A few scientists took the traditional view that credibility depended on scientists remaining neutral and objective; "And the credibility part - certainly, you know, if you go too far over into advocacy, you will undermine credibility" (P14 S 351). Many scientists thought that science was inherently credible because of the scientific process. Of the 45 quotes on scientific credibility, 18 were from scientists, half of which claimed that the scientific process and peer review were the source of credibility for scientists, and P21 makes this point:

> We have satellites, we can, you know, we do the measurement of all these things. So, I mean, you know, I'll give you the simple example, long before probably we even talked about it, there were people - people who live on the land who, you know, are very close in contact with the natural environment who probably detected changes, but, you know, nobody puts any credibility in them. So I am vested with credibility, I feel like it's my end of the trust, you know, relationship that I have with society to say I'm seeing something that I think you at least want to pay attention to (P21 S 81).

It is notable that P21 seems to confirm, at least in their view, that scientists do not imbue the public with any credibility. The argument above is similar to the scholarly view that scientists' authority is their expertise. However, in subsequent paragraphs, P21 challenges the traditional commitment to neutrality and objectivity, which they argue is illusory and cumbersome if not inconvenient. Above they claimed a special expertise that others did not have; below they questioned whether scientists should claim a special stance due to their objectivity and neutrality. While these passages seem discordant it portrays a scientists wrestling with the tension between their aspiration for normative influence and the social norms of science, which is salient in sustainability, given its normative dimension.

> I actually don't think that trust only hinges on neutrality and objectivity. I think it's one of the grand illusions of science that, you know, especially natural science, that they're somehow value free or something like that. And I don't think

actually people expect me to be value free. In fact, if I were value free, I think people would probably freak out, you know (P21 S 85).

Well, you know, what I find really intriguing is - like the question for me would be how do we shift the perception in science, you know? This self-delusion that we seem to perpetuate that we are somehow neutral and objective and the rest of them aren't and that we therefore have some special stance to begin with (P21 S 97).

While the mainstream climate science community and the IPCC argue that the strength of consensus provides credibility, scientists P12 and P19, below, thought that credibility could suffer from myopia in being too committed to the mainstream view and not open to the possibility that new knowledge might be relevant and might significantly alter the existing paradigm. This is reminiscent of some criticism of the IPCC, both by scholars and opponents of the scientific consensus.

There are quacks out there who are pot - you know, firing pot shots, you know, and don't really do first-person research, but there are also Jack Eddy's[12] and how is one to know? And the mainstream is always vulnerable to shooting, you know, somebody that, you know, and I think this environment that we have in climate communication right now smells of that possibility (P12 S 401).

We spend an awful lot of time focusing on greenhouse gasses… We know almost nothing about many of the other things. Why don't we spend some time

[12] Jack Eddy was a solar astronomer who was ostracized for challenging the scientific orthodoxy about the stability of the sun. In a 1976 paper called *The Maunder Minimum,* that was published in the American Journal of Science, he argued that sun spot cycles which were thought to be stable were actually variable in important ways that had impact on Earth's climate ("Jack Eddy," 2009).

researching those? They might make the situation way worse than we think it is now. They might make it better. We don't know because we don't spend any time studying those things (P19 S 77).

Non-Scientists thought that climate scientists simply were credible. Many non-scientists associated credibility with prestigious organizations, or the peer review process, or simply from the weight of the evidence. Non-scientists tended to imbue scientists with credibility: "Scientists' credibility remains high. Every poll shows that they are among the most trusted sources for the general public" (P7 NS 59). Others referenced prestigious institutions as sources for credible information: "We try to imply that either by giving a credit line on the graphic that we use that this is from NASA or from NOAA or it's a Science Magazine article XYZ" (P4 NS 97). Some thought that the sheer weight of the evidence about climate change provided credibility: "I think it's clear that global temperature is increasing. That's fairly unequivocal. You've got to do something very perverse to convince yourself that it isn't" (P11 NS 127). Non-scientists used this reasoning to argue that scientists should advocate more.

However, non-scientists thought that credibility would suffer from dishonesty, and they cited honesty and openness as necessary ante for credibility: "Well, we're very open, so, you know, we're publishing our data so we're giving you access to the same data that we're looking at" (P23 NS 135). P2, below, argued for accuracy which is similar to honesty in validating objectivity, or adherence to facts. Given the common aversion to advocacy it is interesting that P2 seemed to reveal their role as an advocate by implying there were advocates on both sides of the climate change debate:

> You need to have your I's dotted and your T's crossed because if you don't, you're going to, you know, you're – people who oppose what you – you know, the advocates on the other side will call you out and will attempt to discredit you simply because you have your facts wrong (P2 NS 121).

Some non-scientists thought that factual information should be kept separated from politics or advocacy in order to preserve credibility: "What does climate change mean? Is it something we should pay attention to and why is that, what's causing it? And when it gets to solutions, that's where it comes into the political process" (P4 NS 63).

For non-scientists the social norms of science were not salient and some were unequivocal about objectivity being impossible: "Well, I might say that in my field, in my discipline, nobody believes that objectivity is possible and that they haven't for a long time. So, objectivity is not an issue for us" (P10 NS 138).

Of the 45 quotes on scientific credibility in CCC, 27 were from non-scientists and were distributed across a variety of ideas. Notably, no non-scientists thought that scientists should remain neutral and objective, the concept was not a concern. Instead the dominant idea expressed by non-scientists was that scientists simply were credible. The second most cited theme was that honesty and openness were vital to preserve credibility, followed by the need to remain carefully true to the facts of the science.

Commentary re: Opinions on Credibility in CCC

The scientists that I interviewed all valued their scientific credibility in some way, and they understood Mertonian norms whether they accepted the requirement for objectivity and neutrality or not. Only a few of the scientists thought they could openly or truly advocate for climate policy without damage to their credibility. Most scientists reasoned that their credibility remained intact because, based on their definition of it, they did not truly advocate. Most non-scientists seemed perplexed that scientists were concerned about credibility and thought that scientists could advocate openly, and that scientists could do so without damage to their credibility, because scientists' credibility was simply inherent to them. Non-scientists were either dismissive of or they did not understand scientists' frustration with the norms of objectivity and neutrality.

The CCC Audience

Scientists were strategically focused on decision-makers. Subjects were asked who their CCC audience was, why they mattered, and what their objective was in targeting that audience. While scientists often listed the public among their audiences they largely did so as a matter of fact, often within a list rather than as a deliberate choice: "My audience - it varies. It's a lot of - its government people, so people in agencies, congressional staffers, congress people themselves, it's the public, students, K-12, college students, it's - I want to say everybody" (P17 S 25). Only one scientist mentioned communicating with the general public in order to build support for climate policy, but they then indicated that this was at the request of local government rather than their own choice, and they characterized the effort as informing their audience. However, most scientists identified decision-makers as their target audience, and that they were important because decision-makers could enact policy or lead change, and most scientists' stated goals were to persuade decision-makers to support climate policy.

Scientists repeatedly identified policy-makers as an important audience: "We scientists can talk until we're blue in the face about what's going to happen, but the people who are making the decisions are ultimately going to be the ones who need to sign off on these solutions" (P17 S 33). This scientist identified only decision-makers as necessary to approve solutions; the public was not recognized as important. Other scientists expanded their focus on policy-makers to include other influencers. "So, I'm making sure that those people, leaders in industry, leaders in society, leaders in governmental sectors at all levels. To me those would be the audience" (P16 S 37). "Policy makers is one big place, engineers and land use, you know, folks (who) set a lot of the policies of how we actually, you know, where we emit (GHG). Technology folks, engineers, corporate, you know …" (P21 S 71). "I mean, that's my hope that we reach out to (influencers) and policy makers who will set the right tone" (P21 S 73).

Scientists focused their communication strategically on those who could make decisions on behalf of society, whether or not there might be broader public support. "It's a social change process, and to start that, you don't need ninety percent of the population to get there, you need ten percent… And so, you know, if we can target the right folks, the right (influencers)" (P21 S 63).

> I think, you know, this is like paraphrasing some remark by Margaret Mead that change has always been, you know, the agency of change has always been some committed five or ten percent of society. Kind of drags the rest along, kicking and screaming or something along those lines (P14 S 113).

Scientists P14 and P21, above, described a social change process that could be led by perhaps ten percent of the population. However P21, below, describes the scale of the required social change in terms of a total and distressing social transformation. But no evidence was offered to suggest that such precipitous social change could be led by such a small group. P21 observed a disconnect between what climate scientists were suggesting for mitigation and what was truly necessary, which is reminiscent of Broecker's criticism that the mainstream mitigation regime was implausible (Broecker, 2010).

> It's hard to get used to and submit to, you know, change just because its change, not because, you know, you might not like the outcome, it's because the change is hard. I have to give up every one of my habits. I have to do things very differently and whatever. So I think, you know, the magnitude of the transformative change, I don't think even communicators have realized what that all implies and I think even physical scientists who study climate change understand it better than most of them. I think they haven't quite understood what that all implies and why people aren't just like flocking to them to oh, great, let's bring it on. And then to manage a population that will be deeply in distress (P21 S 57).

Non-scientists were strategically focused on the public. Only two non-scientists identified policy-makers as their audience, and they characterized this as merely the nature of their work rather than as a deliberate choice. A consultant indicated: "We're providing messaging to people who are - have - a lot of them are water resource (planners), that's my audience at the moment" (P8 NS 61). The other identified policy-makers as simply one among their audiences. Most non-scientists did not deliberately pursue policy-makers, but when they gave their reasons for focusing on the public audience, several referred to the need to build public support for climate policy as a prerequisite for policy-makers to be willing or able to support it. The following quotes show how non-scientists were strategically focused on public audiences:

> We talk a lot about the general public and particularly the conservative segments of the general population, and I see that as a very important audience because without bringing the public as a whole, we can't shift attitudes in the Unites States (P8 NS 29).

> But often what you can find is an issue with a politician where they feel that they could not introduce a measure or policy because they feel that the public would be hostile to it, although they would find it difficult and what they seek is the expert community to create conditions in terms of public debate in which they are able to make those recommendations (P11 NS 63).

While the non-scientists were largely focused on the public audience, there was no consensus regarding communication tactics. For example: some non-scientists thought that it was important to directly address climate deniers while others thought deniers should be avoided:

> We also need to speak to people in the middle and also, quite frankly, we need to speak to the people who, you know, deny or oppose anything around climate change, if only to neutralize them. So, that's our approach (P2 NS 37).

> So in one sense, it's - we're writing for people who are in danger of being influenced by misinformation. We're either inoculating them or disabusing them of misconceptions, so our target audience is definitely not climate deniers because the psychology tells us, that it's almost impossible to change those people's minds anyway (P6 NS 57).

No empirical evidence was offered in support of claims such as: "We're either inoculating them or disabusing them of misconceptions" (P6 NS 57), or "we need to speak to the people who, you know, deny or oppose anything around climate change, if only to neutralize them" (P2 NS 37). It is more accurate to characterize these statements as aspirational rather than factual. Many of the non-scientists described communication tactics, offering only anecdotal, if any, evidence of effectiveness.

Commentary re: The CCC Audience

Most interviewees felt that the objective of CCC was helping their audience to understand the scientific consensus about the risks that climate change posed for humanity, and persuading their audience of the urgent need to take action to mitigate climate change. Perhaps the common purpose in CCC is best reflected in this quote from a scientist:

> I have realized how crucial it is to be able to connect science with decision makers… There's this problem (climate change) and we're causing it, and instead of squabbling over [it] - I don't even want to call it a debate and give it that legitimacy, but instead of squabbling, something's happening, we need to do something about it. We're causing it and now it's time for solutions. (P17 S 17)

The two most common audiences cited for CCC were the public and policy-makers. In addition, interviewees communicated with scientists to help them stay abreast of developments in other disciplines, they communicated with journalists to provide newsworthy information on climate change, and they communicated with students and faculty in the course to teaching climate science. However, when communicating with the public or with policy makers, their common stated purpose was to influence the audience, to change minds, to encourage action, and they considered certain audiences as critical to meeting their objective. Notably, a distinction emerged between the views of scientists and those of the non-scientists as to which of the two audiences were important and why.

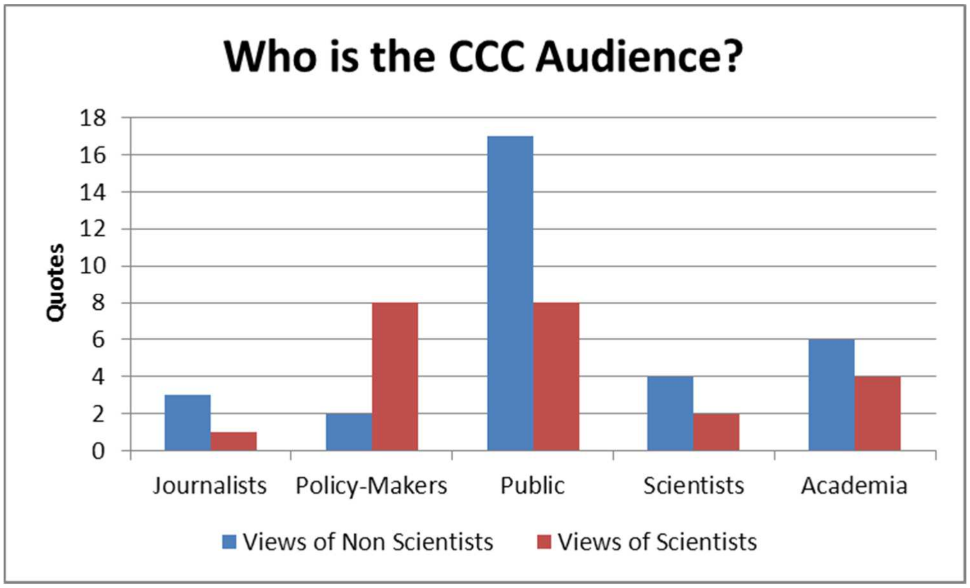

Chart 3. Number of times that scientists and non-scientists identified various audiences for Climate Change Communication. Non-scientists were more focused on public audiences, while scientists were numerically split but strategically focused on policy-makers. Scientists identified the public with equal frequency; however they largely did not view the public audience as important to their communication objectives.

Non-scientists were strategically focused on the public in order to build public support for action to mitigate climate change while scientists were strategically focused on decision-makers in order to convince them to lead change on behalf of the rest of society. The scientists largely did not view the public as important in the discourse regarding what should be done to battle climate change.

Conclusion

All of the scientists and non-scientists that I interviewed were motivated to improve CCC effectiveness. At a fundamental level, they shared the objective of improving societies' capability to make policy decisions that would reduce the risks that climate change posed for humanity. However, beyond improved decision-making, most desired a particular outcome to emerge from that decision-making process, and they approved of the prevailing global climate policy initiative. Most argued for the prevailing climate change mitigation regime but did not think of themselves as advocates. Non-scientists simply stated that they did not tell people what to do, while many of the scientists provided rationalizations that reconciled their behavior with the social norms of science. Although scientists generally denied they were advocates, many nevertheless focused their communication on policy-makers with expressed intent of influencing them to enact climate policy. As with the IPCC analysis in Chapter 5, there was an evident belief that scientists I interviewed could engage in policy deliberation, or provide policy advice, and remain neutral and objective.

As with the scholarly views in Chapter 2, there was no consistency among my interviewees about scientist advocacy. AAAS conferees essentially punted the advocacy issue, leaving scientists and organizations to develop their own perspectives and norms (AAAS, 2012). Not that the AAAS would or could be the authority, nor that it is their responsibility to attempt it. Rather it is emblematic of the conundrum scientists face when confronted with the tension between advocacy and the social norms of science. Arguments on both sides of the advocacy issue are compelling and a clear choice is not readily apparent. There simply is no useful consensus about advocacy to guide scientists. With no universally accepted definition, the scientists I interviewed tended to define advocacy in personally satisfying terms.

The scientists I interviewed appeared torn between their desire to protect humanity from dangerous climate change and the norms of objectivity and neutrality. While some scholars continue to insist that the social norms of science are imperative, some of the scientists I interviewed regarded these norms as a sort of Mertonian hangover, a restrictive relic, and a barrier to their desire to advance climate policy. And yet most scientists interviewed continued to rationalize that they did not personally engage in advocacy. Although they coveted freedom from the Mertonian norms, many reasoned that they did not violate those norms. The non-scientists were largely puzzled and dismayed by scientists' tendency to rationalize and eschew advocacy and most thought that scientists simply were credible and would remain so, and that scientists should simply be more active policy advocates. In fact, many non-scientists argued that scientist advocacy was urgently needed and some argued that it was scientists' moral responsibility to not just warn society of the danger but to actively advocate for climate policy to the best of their ability.

Research has shown that public trust in science falls when scientists engage in policy discussions (Krosnick, 2012), and IPCC authors have expressed concern that the pressure on them to remain neutral could limit their policy relevance (Edenhofer, 2014). The stakes for scientists who advocate are real and the challenges are complicated, and unresolved. The conflict between advocacy and the social norms of science is likely to be unavoidable for sustainability scientists who wish to exert a normative influence in solving the problems that they study.

CHAPTER 7

CONCLUSION

Synthesis of earlier chapters

Without the influence of scientists, societies may make catastrophically poor decisions and sustainability science specifically intends to guide societies along a more sustainable trajectory. Sustainability scientists are challenged with wicked problems like climate change, which take them beyond traditional descriptive science and into exploring solutions. From the dawning realization of its risks, climate change has fundamentally involved scientists persuading the rest of the world to implement ideas for managing those risks, and scientists have moved casually between science and solutions but the distinction is profound. Beyond a relatively orderly, peer reviewed scientific process, exists a disorderly, un-refereed persuasion space in which stakeholders, including scientists, selectively color the facts and advocate for their own interests and value systems. The negotiation among stakeholders necessary for the development and implementation of solutions entangles scientists in advocacy, creating a host of problems and challenges for which scientists are poorly prepared.

Scientist advocacy is thought to violate certain social norms of science and society largely expects scientists not to act as partisans. However, because scientists are subjective, some level of advocacy is likely, and in environmental controversies scientists may be perceived to advocate regardless of their intent. Since they are solutions-focused, sustainability scientists are even more likely to engage in advocacy than other scientists, as they develop and promote solutions or provide policy advice. However, sustainability scholars have largely presumed that these scientists possess the capacity to influence society, while in practice stakeholder resistance has stymied scientists' efforts to persuade society to change, as is the case with climate change.

Many sustainability scientists have been frustrated with the limited response to their proposals, while some PUS scholars have questioned whether science should expect to prescribe assessments and solutions to society. Scientists' concern about policy inertia in climate change has led to the study of CCC with an eye toward increasing its effectiveness. Although CCC has generated discourse about revolutionizing its practice with more participative communication, scientists have revealed a continuing preference for linear communication and privileging scientific knowledge.

While scientific knowledge remains important to society, an abiding challenge remains in establishing the appropriate level of influence for science in policy making. The practice of IPCC communication reveals the difficulty scientists face in producing policy relevant but policy neutral information. My analysis suggests that the articulation of judgment, opinion, and values within the climate change controversy in IPCC reports represents the effort of the authors to persuade the audience of their reading of the matter. Conversely, perfectly neutral language, devoid of opinion, values, and judgment, will not be policy relevant. Essentially policy relevant but neutral communication is impossible and any language beyond the factual will likely entail an attempt to persuade in some way. In applying this conception of advocacy, my analysis of the WG1 SPMs from 1990 and 2013 reveals that while the use of factual information tripled by 2013; both reports were still dominated by the authors' opinions, values, and judgments suggesting that the effort for policy relevance necessarily entails some level of intent to advocate for the scientific consensus assessment and policy recommendations.

My interviews of professional climate science communicators revealed that all argued for climate policy, most denied that this was advocacy, and most scientists struggled with the pressure to remain neutral and objective. Scientists often defined advocacy in terms that exempted their behavior from it, thus reconciling with the social norms of science. While eschewing advocacy, most scientists revealed that they nevertheless strategically focused their communication on policy makers, with the stated intent of influencing them to enact climate policy. On the other hand, most non-scientists that I interviewed were not concerned that scientists remained neutral and objective, and they thought that scientists should advocate more actively, with some insisting that it was scientists' moral obligation to advocate to prevent social harm that might occur if they did not act.

"Once more unto the breach, dear friends, once more"

(Shakespeare's *Henry V, Act III*, 1598.)

Salient Conclusions About Scientist Advocacy

Societies value and depend upon the influence of scientists and the debate about scientist advocacy interferes with the contribution that many scientists wish to make to important science based policy decisions. Many scientists feel morally obliged to warn society about danger they discover through their research and scientists have the right to advocate for action that they believe will reduce that danger. The behavioral norms of science should not prevent scientists from exercising their rights as citizens to advocate for policy changes if they choose. Scientists who engage in policy discourse will advocate in some way and likely damage their credibility in the process. Scientists will have to individually reconcile the normative questions about advocacy and determine whether to assume the risks that accompany their engagement in policy discourse or advocacy.

Scientists concerned about advocacy face a conflicting array of ideas about it but at a fundamental level it is understood to involve scientists urging a course of action or expressing public support for a particular cause or policy. However, there is considerable disagreement among scholars about precisely what behavior advocacy entails. Given this confusion, it may be more helpful for scientists to assume that advocacy is nearly unavoidable and that scientists are very likely advocating once their discourse ceases to be purely factual (verifiable), and value-free. Once policy relevant discourse begins, some level of advocacy will likely be revealed through the scientists' expressions of opinions, judgments, and values.

Proposed Concepts

Based on this research, and for reasons detailed below, I propose that only communication that is objective and neutral be considered free from advocacy. Objectivity requires adherence to facts (the verifiable), and neutrality means value-free. Communication that strays from the facts or becomes value-laden will then involve some level of intent to persuade, and when scientists do this, it is scientist advocacy.

This research provides the opportunity to propose a framework of the salient components of scientist advocacy as presently manifested in concept and in practice. In Figure 5 below, a table displays the components of advocacy arranged in columns, and levels of advocacy in rows, with the level of advocacy increasing vertically. For example, the bottom row describes the lowest level of advocacy scientists might normally engage in the course of routine scientific activity. Examples are given for the kind of activity, characteristic motivation for the scientist, probable audiences, how credibility is mediated, and the likely perception of internal (scientific) versus external (public, including policy-makers) audiences regarding whether the activity is neutral and objective or whether it is advocacy.

At the lowest level, scientist advocacy is largely uncontroversial, audiences are internal, credibility is mediated internally via scientific norms, and both internal and external audiences likely view the activity as neutral and objective. As advocacy levels increase, so too does the likelihood of controversy; audiences become increasingly external and credibility is decreasingly mediated internally, and increasingly mediated externally. With increasing advocacy, scientific credibility and authority as determined by internal scientific norms, decreases until nearly irrelevant in the highest levels of scientist advocacy. Even with modest forms of risk assessment or risk management, public audiences perceive scientists to be advocating in some way while internal (scientific) audiences may continue to view the activity as neutral and objective until a scientist is clearly advocating for specific policy proposals.

Thus the point at which scientists' activity becomes advocacy is blurred between internal and external perspectives, yielding a significant area for disagreement regarding what is or is not objective and neutral. In the second and third levels, risk assessment and risk management activities that scientists may view as neutral and objective and solely scientifically determined may be viewed by public audiences as advocacy. Only in the very lowest level of advocacy, in which scientists are performing routine scientific work, do both internal and external audiences mostly agree that the scientific activity is neutral and objective. Even then, the public may perceive scientists advocating in their own interests, perhaps for grants but this would rarely become controversial. This lowest level of advocacy provides potential areas of agreement upon which scientists and the public and policy makers may build consensus in negotiating policy. However, there is not an objectively determined set of facts and even at the lowest level of advocacy; the accepted facts may be a matter of negotiation between scientists and the public and policy makers.

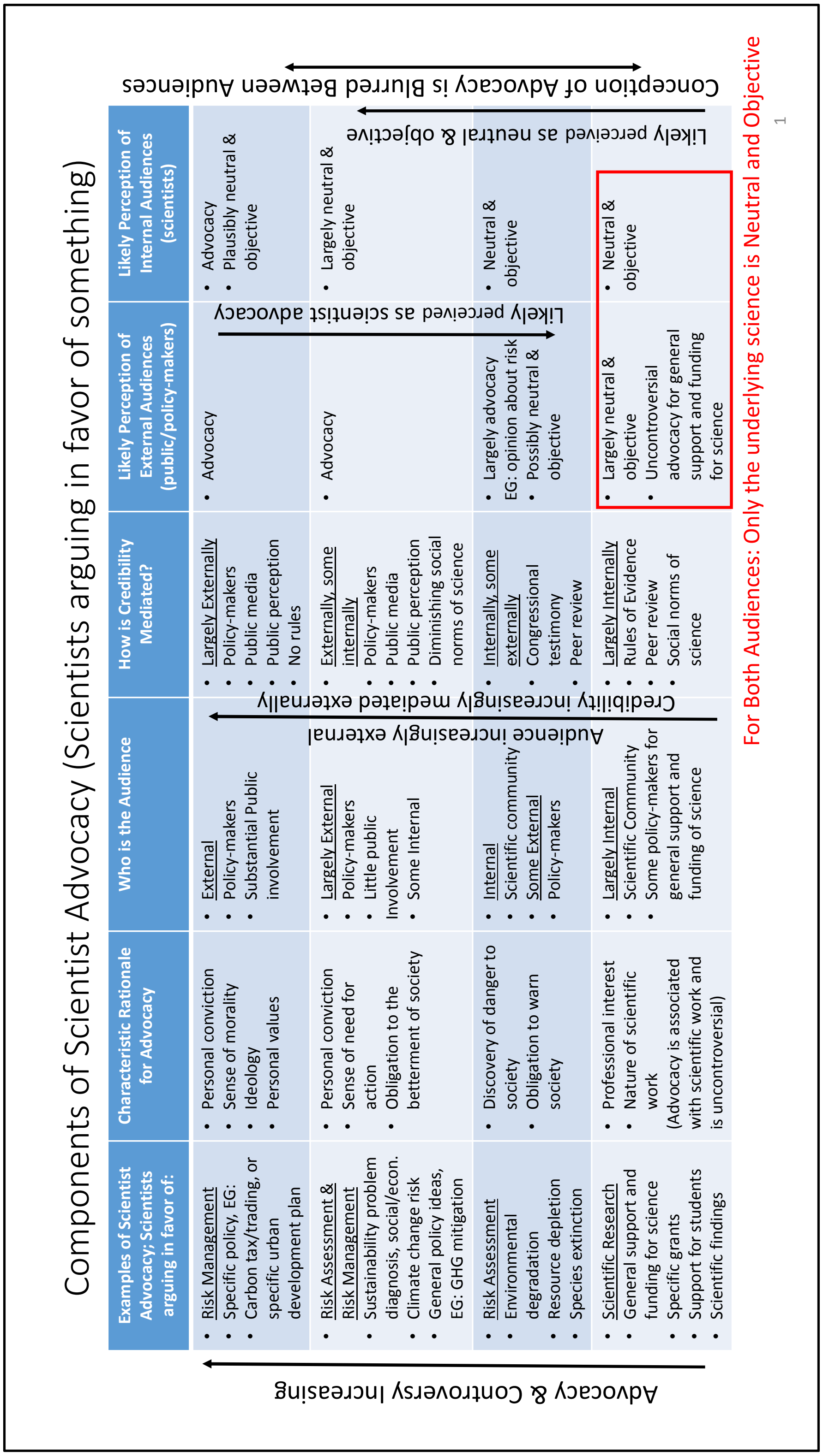

Figure 6. Components of Scientist Advocacy

Figure 6 below, is a diagram that depicts the concept of scientist advocacy as commonly practiced and which became apparent through this research. The intent of the representation is to show how little activity is presently considered by scientists to be advocacy. Outside of direct advocacy for specific policy proposals, a great deal of risk assessment and risk management is variously rationalized by scientists as solely scientifically determined, neutral and objective thus bearing the credibility and authority of science, and therefore not advocacy. In denying advocacy, scientists minimize the contribution of their own biases, opinions, values, and judgments to the development of their policy ideas. By imbuing their ideas with the credibility and authority of science they minimize the credibility of other stakeholders, and often view a public rejection of their ideas as a rejection of science.

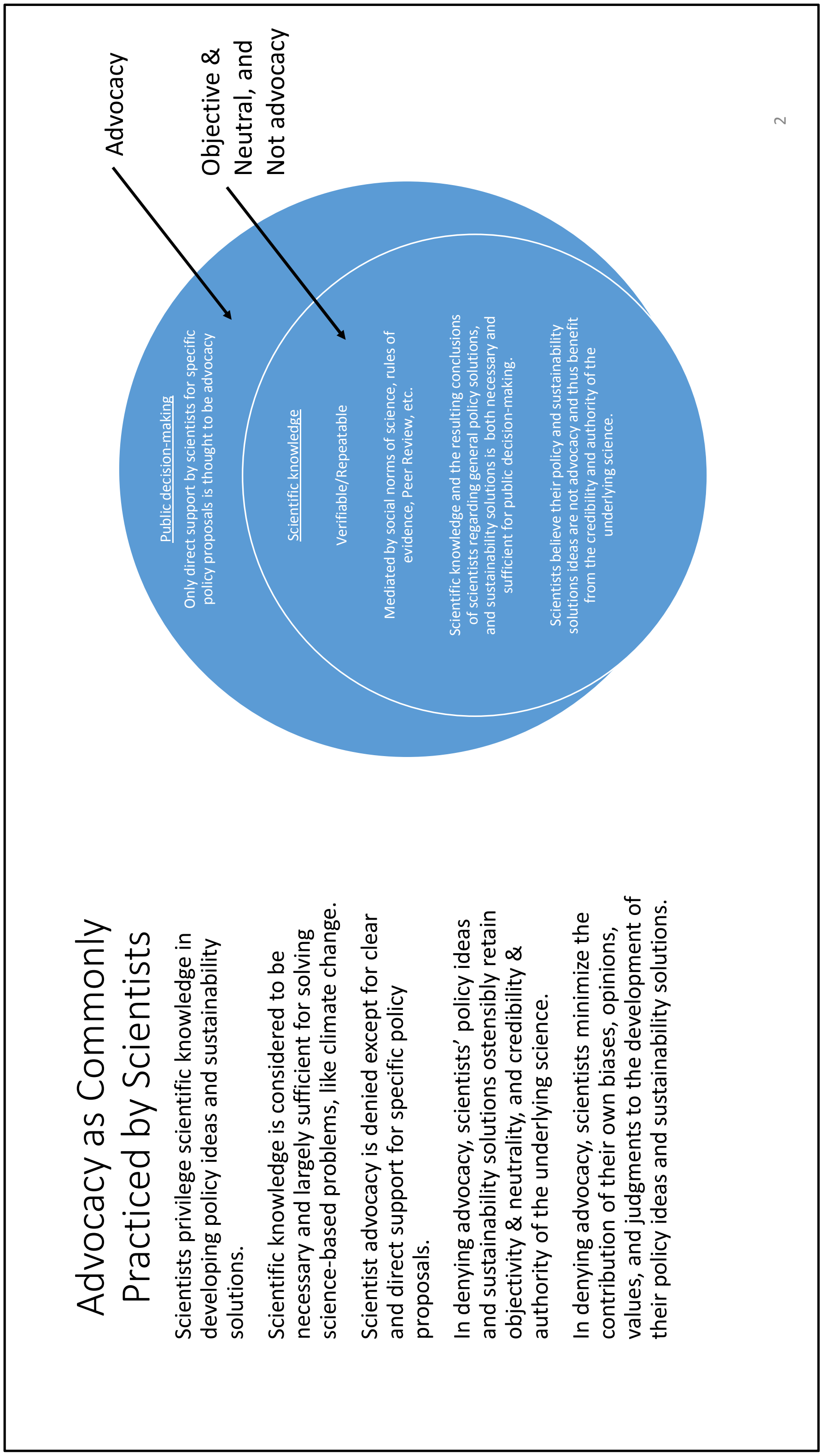

Figure 7. Advocacy as commonly practiced by scientists

Figure 7 below, is a diagram that depicts a proposed framework for scientist advocacy, one that may avoid a great deal of the problems described above, and offers scientists the opportunity to improve the effectiveness of their advocacy in the negotiation of public policy. Supported by the foregoing research, scientists in the proposed framework assume that they are advocating when their communication is not strictly factual (that is verifiable) and value-free. Scientists assume that science is necessary but not sufficient for solving problems such as climate change. Scientists assume that they cannot impose their facts on the public and policy makers. In some cases even the facts of the matter may be negotiable among the stakeholders but once agreement is achieved, form a framework upon which policy decisions can be based. In this proposed framework, a much smaller proportion of public decision making criteria are determined by science and the balance is assumed to be mediated by negotiation and persuasion. Scientists still leverage the credibility and authority of science but learn to find its limits, and know that science cannot trump the other stakeholders. In assuming a weak position, scientists may prevent presuming strength that is truly not available to them. Scientists who accept these assumptions will afford themselves the opportunity to better prepare for an engagement with the public and policy makers in which there are no rules and no referee.

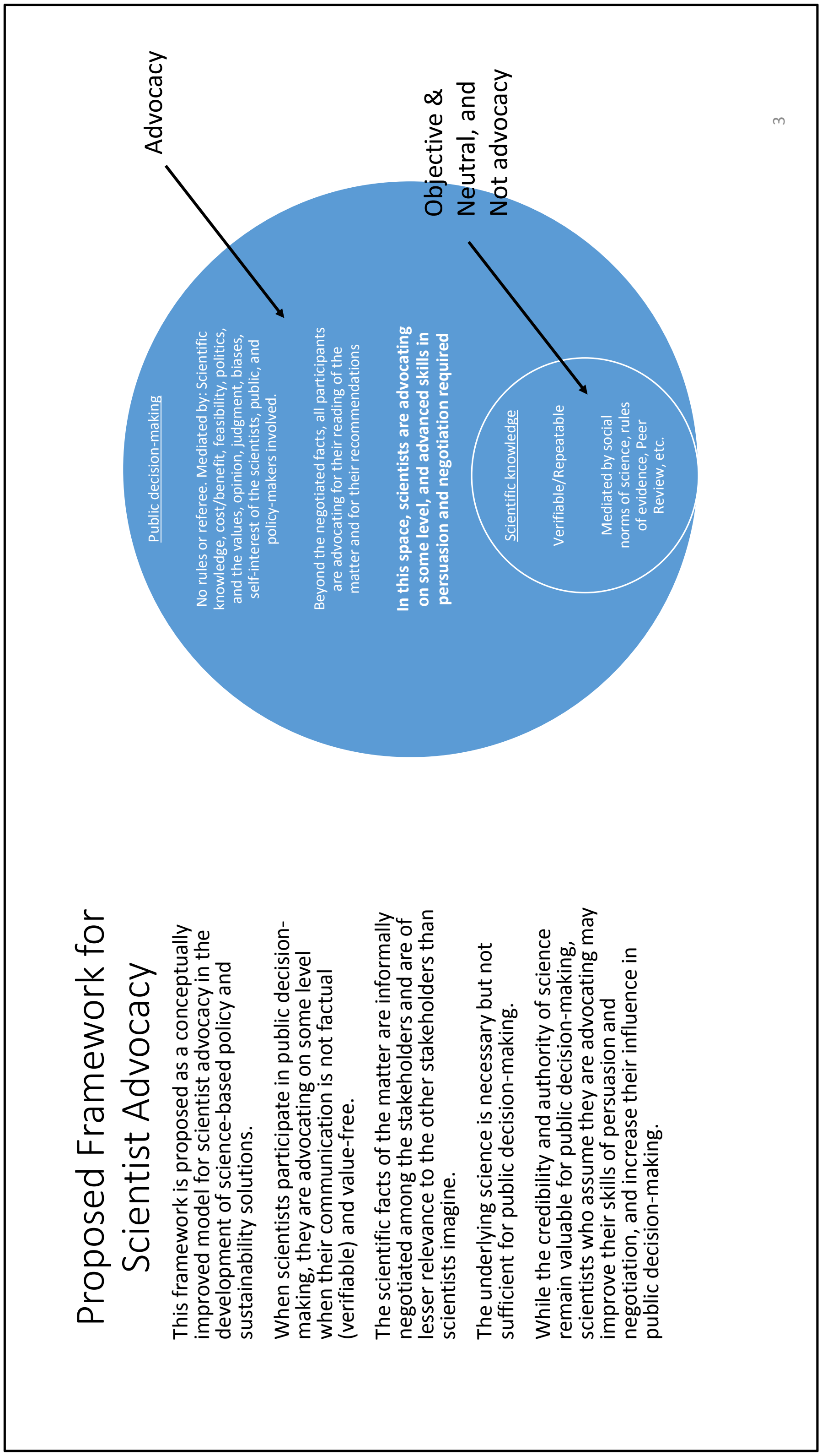

Figure 8. Proposed framework for scientist advocacy.

Discussion

Since history and logic indicate that advocacy may be unavoidable in controversial issues, it may be easier to identify communication that is not advocacy. The eighteenth century Scottish philosopher David Hume argued that one could not make normative statements based on facts about the world. This is considered the "is – ought" problem and Hume argued that the shift from what is, to what ought to be, could not be achieved based on facts alone and required the application of sentiment. For Hume, the "is" was not controversial but the "ought" was (Morris, 2014). Scientific facts, what is, may be considered objective and neutral and free from advocacy, however only if not linked to what ought to be.

Scientists who assume they may be advocating once they depart from factual discourse, may then conceptually separate fact based science from advocacy and treat the two activities as being distinct with different governing norms. Many of my interviewees thought that science and advocacy should somehow be kept separate, and some attendees to the AAAS conference on scientist advocacy also endorsed this deliberate separation (AAAS, 2012), but this requires establishing when advocacy occurs. Short of an authoritative definition, scientists may dispense with a great deal of rationalization by assuming that advocacy takes place whenever they stray from factual and value-free discourse. In this way, scientists may preserve and even enhance the credibility of their science by maintaining its objectivity and neutrality, and isolating that from subjective and value-laden discourse.

In Chapter 5 I argued that strictly factual communication in the IPCC 2013 SPM increased threefold over the 1990 SPM. The IPCC authors stripped those factual statements of subjectivity, which significantly added to the credibility of the report by providing a great deal more verifiable information. For example: “The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased (IPCC, 2013b, p. 4). The sentence is worded to be factual and offers documentation to support the claims. In contrast, similar material in the 1990 SPM was prefaced with: “It is our judgment”, without distinguishing what might be factual and what was not. Certainly climate science knowledge had increased by 2013 but recall that the IPCC deliberately chose for the 2013 report to assert verifiable information as fact and to use uncertainty qualifiers for the rest. This is a move in the direction that I suggest is prudent. Scientists may still be challenged about their factual claims; however if not mingled with subjective expressions, statements that can be verified to the satisfaction of stakeholders could form a foundation for further dialogue.

For example, repeatable scientific experimentation can verify the fundamental physics of global warming; the natural greenhouse effect, enhanced greenhouse effect, the global warming trend, and the human fingerprint of fossil carbon in the environment, to name a few (IPCC, 2013a). The accepted factual basis then can include predictions that with continued GHG emissions global temperatures will increase and sea level will rise. Such verifiable information may form a basis for policy negotiation provided it is not mingled with conclusions, opinion, and values not shared by the other stakeholders. Thus the negotiated factual basis for policy development may be smaller than scientists hope for, but more credible with audiences that are critical to policy development.

In this model, climate scientists' focus on the science would be to maintain its credibility as verifiable, and their focus on the balance of their communication could be to improve their persuasive effectiveness in advocating for climate policy. For example, if one were to decide that beyond the underlying empirical science, the fundamental purpose in climate science was persuading society to take action to mitigate climate change, then one could focus on the objectivity, neutrality, and verifiability of the science and separately focus on persuasive effectiveness in advocating for climate policy. A caveat however requires that scientists not conflate their science with their policy ideas, which also requires the concession that the facts about the science cannot dictate policy prescriptions. Conversely then, a rejection of scientists' policy ideas does not necessarily comprise a rejection of the underlying science.

In the past scientists have moved casually from facts to policy but in this model they would view the two as distinct and avoid mingling facts about the science with subjective representations of any kind. In policy discourse scientists could then recognize that their policy ideas will be informed by their opinions, values, and normative frameworks, as it will for other stakeholders who may consider the facts and develop significantly different conclusions. If scientists guard against the idea that science dictates policy, they may be more flexible, more persuasive, and more effective at ultimately advancing their policy objectives.

Science/Policy Interface

There is a great deal of academic interest in the challenges associated with the development of science based policy. Sustainability scientists have embraced the challenge of problems like climate change which are termed wicked not just because of unforeseen trade-offs and unintended consequences, but also because they are perceived differently through the biases of the stakeholders, their solutions are political, not likely to be settled with additional scientific facts, and have to be continually deliberated (Rittel, 1973). Work with boundary organizations and stakeholder engagement has advanced the understanding of the dynamics at play in the interface between science and the public (Clark et al., 2011 for example; Talwar et al., 2011). Scholars have advanced theories and frameworks to improve our understanding of the dynamics of stakeholder interaction, and to identify opportunities for improvements in the process of public policy development (A. Schneider, Ingram, H., 2007). Any of these tools may be helpful in the existing science/policy paradigm, yet like CCC, proposed improvements are largely tactical and still encumbered with the conflicting conventions of neutral and objective science versus a values dominated policy process.

The science/policy interface is particularly challenging in sustainability science, which has been described as a new kind of science because it is normative and specifically intended to influence policy development (R.W. Kates, 2011). Yet its simple characterization as normative may understate the paradigm shift truly implied. In tackling problems like climate change, scientists have chosen nothing less than to reorder the world. For example: stabilizing GHG emissions requires an eighty-five percent reduction in fossil fuel use (Broecker, 2010) and ultimately solving climate change requires a completely carbon-free energy system and may require carbon capture and sequestration (Broecker, 2013).

Few objectives imaginable could more definitively situate sustainability scientists as solution-oriented as choosing to solve climate change. But the discipline of sustainability may not be optimally deployed given the task at hand. Recall how IPCC authors struggled with the challenge of engaging policy matters and remaining neutral, and how most of the climate scientists that I interviewed resisted open advocacy. The social norms of science are an impediment to sustainability scientists' unrestrained advocacy for the transformative social change they may covet, and this challenge has largely been skirted in conceiving of the normative role for sustainability scientists. Comparatively simpler problems have yielded to present conceptions for science/policy development. For example: the Vienna Convention and related Montreal Protocol were successful in mitigating stratospheric ozone depletion and were the model used in planning for a similar climate change convention (IPCC, 1990a). But the UNFCCC and Kyoto Protocol designed to tackle climate change have not shown the potential to appreciably impact the problem. While climate change may not quickly yield to human intervention and there are no magic bullets, other disciplines that focus on achieving results offer organizing principles and norms that may improve goal attainment for sustainability scientists.

Results Oriented Management

Results Oriented Management (ROM) has become a sub-discipline of management that is employed to organize and deploy in the most effective manner possible to achieve primary objectives. While its roots are in business, in 1993 the U.S.

Congress passed the Government Performance and Results Act (GPRA) in part as a response to the demand for accountability in federally funded Community Action Agencies (CAA). Based on a system designed by the Drucker Foundation, some CAAs developed a process for strategic planning and accountability called Results Oriented Management and Accountability (ROMA) which "incorporates the use of outcomes/results into the administration, management, operation and evaluation of human services" (CAMP, 2007, p. 7). Effective ROM begins with strategic planning which involves establishing answers to key questions about the organization's purpose, customers, desired results and plan, which is ubiquitous in business but has recently found application in government organizations with the specific intent of improving their results attainment.

One key aspect of ROM is accountability for results (thus the A above), which is viewed as critical and is commonly characterized as "what gets measured is what gets done". Other reasons for measuring results include the need to recognize success and distinguish it from failure, to reward success instead of failure, and to learn from both (Osborne, 1992). Results are always measurable and articulated in the planning process of setting goals. However, goal setting occurs later in strategic planning, preceded by more important steps that have been shown to be critical in impacting overall achievement.

Through five years of research for their 1994 book *Built to Last: Successful Habits of Visionary Companies,* James C. Collins and Jerry I. Porras studied eighteen companies whose performance since 1925 had outperformed the general stock market by a factor of twelve. They found that these organizations had formally established an unchanging core ideology about their values, purpose, and vision for success. Purpose, called "mission" by the Drucker Foundation, answers the question: “Why do we exist?” Vision is a vivid description of success, and answers the question: “What does success look like?” Purpose and vision are centered on some sort of audacious long-term goal. Collins and Porras found that these successful companies’ core ideologies consistently informed behavior throughout their organizations to which they attributed their success (Collins, 1996). At this stage in the ROMA planning process, the Drucker Foundation also considers and identifies the customer and their values. While in practice strategic planning varies in some details, it remains fundamentally a question of establishing a purpose and a vision for long term goals, such that they effectively inform the rest of the organization’s activities.

An important part of strategic planning, from whence it derives its name, is strategy development and it is poorly understood and often mistakenly tackled before the organization has achieved clarity about its purpose and vision. Essentially strategy is the decisive deployment of resources and is usually defined by scarcity and opportunity costs; one never possesses all of the resources one might like, and must choose carefully how they are used. Strategy is rather pointless if not informed by clarity of purpose and vision. Tactics then are employed within a strategy and determine how resources are used.

The literature revealed a great deal of attention given to improving CCC, however most of it was focused on the tactical level, which cannot establish clarity for an individual scientist or their organization about important questions of purpose, vision, goals, and how to deploy resources. These questions can only be answered via difficult, often soul-searching work in strategic planning. In solutions oriented science such as sustainability science, little effort is presently dedicated to results-oriented planning and organization above the tactical level. Top performing organizations focus deliberately and intently on organizational purpose, vision, and goals and on effective planning and managing for results.

There is no guarantee of success as the result of performing strategic planning, and many organizations that do plan create material that merely populates the walls of corporate lobbies and has little guiding effect on the organization. Collins and Porras sifted through hundreds of companies to find eighteen that were exceptional. However, the fundamental aspects of strategic planning and ROM have found traction in a variety of organizations beyond business that are focused on achieving results. Publicly funded CAAs have yielded to demands for better results and accountability for results, and have found value in the employment of strategic planning. The process has helped CAAs to transition from merely performing services because funding was available to developing a firm foundation for their strategies that is guided by their purpose/mission and vision. Strategic planning helps these organizations develop and coordinate comprehensive activities that can increase their achievement and reduce unintended consequences. Importantly the ROMA process is iterative, with any aspect of it available for revision when necessary (CAMP, 2007).

While in sustainability the goals may be noble and audacious, the normative role envisioned for sustainability scientists lacks specific guidance that could help scientists organize more effectively to identify and achieve their goals. Given the common routine for funding scientific research, formal strategic planning for each project may be cumbersome; however any strategic thought seems apropos given the lofty ideals of normative influence that have been proposed, claimed, assumed, for sustainability scientists. Collins and Porras' conception of an unchanging core purpose and vision may find useful application within the scope of any level of leadership from the individual to the IPCC.

As such the comments that follow could apply to an individual scientist or an organization such as the IPCC. Indeed, ROM is frequently applied in business from the individual to the organizational level. Scientists who desire a normative influence in society could apply ROM with the potential to improve results attainment but this requires a deliberate application of ROM principles, including articulating core purpose and vision, performing strategic planning, and managing for results throughout. Rather than moving haphazardly from one research proposal to the next, a scientist or a scientific organization might benefit from formally establishing clarity regarding their core purpose and vision for success, and then planning and managing each project accordingly. These guiding principles would be considered permanent, while strategies, tactics and specific goals could then vary as necessary with each project. Core purpose is thought to be the fundamental reason an organization exists and its vision for success is typically a long-term, aspirational goal and distinct from project specific goals which will change with each project.

For example: A possible outcome of ROM might be that a Southern California urban-planning institute establishes that its core purpose is to improve the livability of urban Los Angeles, and that purpose is held to be unchanging for the institute and to permanently guide the kind of work it undertook. Likewise, its values could be established as: livable, walkable, shady, safe, medium-density urban spaces with convenient and sustainable public transportation. The institute would then deliberately seek projects that fit its purpose and values, while forgoing all others. A common practice in ROM is to express goals in the present tense, as though already attained. For example, the institute's long-term vision for success could be that "its recommendations are accepted by the city council, developers, banks, and the greater community and that its projects are implemented". This core ideology would inform all other activity; the kind of projects undertaken and the goals and strategies associated with each project. The institute would identify key customers and their values; which in this case would be influencers and decision makers, for example the city council, developers, banks and community leaders. The institute would engage those customers from the inception of each project and work with them throughout to reconcile the institute's purpose, values, and goals with those of their customers. Most importantly, the institute would be continuously guided by clarity of purpose, vision, and long-term goals. Clarity about these questions has been shown to improve the attainment of desired results but the ROM process also includes strategic planning and results oriented management.

Strategic planning would require the institute to assess its resources and deploy them in the most effective manner deemed possible, which would include an honest assessment of the institute's capabilities such that it would forego projects for which it was fundamentally unprepared. For example, an urban planning project might involve a sustainable livelihoods component for which the institute was ill-prepared. In this case, a logical strategy might be to partner with another organization that possessed complementary capabilities, or to develop in-house the needed resources for the project at hand. In any case strategic planning involves the decisive deployment of resources and is guided by core purpose and vision for success.

Finally, ROM requires establishing project level goals that are specific, measureable, attainable, results-oriented, and time-phased, and holding the organization accountable for those goals. Accountability for results involves assessing attainment versus objectives at specific stages, and at the completion of the project, and helps the organization celebrate success, and identify failure and learn from both. For example, the institute's recommendations might be accepted by every customer except the developers who reject the ideas, and an honest appraisal of this failure presents an opportunity for the institute to establish the reason for the failure and to act to prevent its reoccurrence.

Climate change is a problem of unimaginable scale and complexity, and yet organizations like the IPCC may benefit from the same strategic planning exercise. Disciplined planning could produce an honest internal appraisal of the IPCC's authentic purpose, which appears to be reflected in their chief executives' consistent advocacy for climate policy. The planning process itself cannot force honesty and rather provides the opportunity, however more clarity about the organization's purpose can relieve its members from conflicting roles such as providing policy relevant assessments that are policy neutral. The primary activity of climate scientists appears to have transitioned from empirical discoveries of disinterested scientists to the fundamental purpose of persuading society about the urgent need for mitigation. Honesty about their purpose has the potential to refocus IPCC energy that is presently dedicated to rationalizations about neutrality, to focus on the policy advocacy its members consistently pursue.

Vendor/Customer Norms

In addition to establishing a guiding ideology, the norms of productive advocacy offer sustainability scientists operational guidance for improving results attainment. While attendees to the AAAS conference on scientist advocacy expressed disdain for any aspects of advocacy that resembled acting like a salesman (AAAS, 2012), in its business to business (B2B) manifestation the sales function provides a meaningful correlation to the challenges of advocacy in science. Not to be confused with negative sales stereotypes, the character and performance requirements for a professional B2B sales person compare favorably to those required for effective advocacy in science. Recall that scientists have scoured other disciplines for relevant knowledge that might improve science communication, and in the spirit of trans-disciplinarity they should not overlook potentially useful knowledge from business.

A great deal of the best practices for effective B2B salesmanship are tacit, and following more than two decades of successful sales management, I can authoritatively articulate its important components which I believe are relevant to the normative dimension of sustainability. I empathize with the frustration experienced by sustainability scientists when they struggle to persuade the public that present investment will yield important future benefits because this is precisely the challenge that B2B sales people routinely face. Convincing a customer to invest in new, but more productive or efficient products correlates with convincing policy makers to implement costly change in the present to secure a future benefit. Certainly, with climate change the stakes are higher than any in business, and the challenge more daunting, yet all the more reason to leave no stone unturned in pursuit of effective advocacy.

Through centuries-long development, the customer/vendor interface is marked by fundamental conventions that mediate the value derived for both vendor and customer. The effective B2B salesperson is the consummate advocate; their customer knows they will attempt to persuade them of something and the sales person makes no secret of their intent to persuade. Sustainability communication will be improved via similar honesty regarding the intent to persuade and by separating that from the scientific facts involved. Scientists would first ascertain or establish the commonly understood factual basis with their audience, and maintain that as credible and distinct from their efforts to persuade. Scientists would recognize that beyond the factual, some level of persuasion was involved, and assume that the scientific facts did not dictate outcomes, which are instead value-based and thus negotiated with the audience.

In the vendor/customer interface, the understanding of both parties is that any negotiated agreement will ultimately be beneficial to both. Either party or both may consider interim sacrifices for future benefit; for example the sales person may offer an introductory discount or the customer may agree to bear the significant up-front cost of the transition to a new product. Both are common and sales people often find they are persuading the customer to assume up-front costs for future benefit. The results of scientist advocacy can be improved by recognizing that the outcome is negotiated and that the audience must agree to the perceived benefits and to the up-front costs, and that scientists may need to make some concessions in order to advance their agenda.

However, neither vendor nor customer will contemplate unbearable costs and both parties possess values that are non-negotiable. As a result, sometimes the vendor/customer relationship is not productive but ideally remains intact, and no key customer is ever entirely abandoned. The sales person may occasionally check with inactive customers to see if anything has changed. Scientists may improve their normative impact by respecting their audience's non-negotiable values and by avoiding the prospect of advocating solutions with unbearable costs. In any case, the rejection of scientists' recommendations should not cause scientists to denigrate or permanently damage their relationship with important audiences.

The sales person knows that the only prospect for their success involves proposals that make sense to the customer according to the customer's value system and worldview and that changing the customer's value system is unlikely. Failing that, the sales person must regroup and return to try again to persuade the customer. The sales person must be sufficiently knowledgeable about the customer to develop plausible proposals and the sales person's credibility with the customer is thus negotiated in the continuing relationship. The sales person's credibility is earned and can be quickly lost by making proposals that are inconsistent with the customer's goals or worldview. The sales person must continually earn the customer's trust and the continuing right to return, and for this to occur the sales person must constantly be honest, respectful, attentive, and responsive. The sales person may never denigrate or disrespect the customer. Rejections, objections, or other feedback from the customer must be taken into consideration in ongoing proposal development, and sales people know they cannot repeatedly return with the same rejected proposal in the hope that the customer will eventually relent. In the same way, scientists who wish to influence public policy must be sufficiently knowledgeable of their audience to propose plausible recommendations. Scientists must earn and maintain credibility with their audience, which is reminiscent of Wynne's 1992 assertion that credibility was not inherent to either party or to the information conveyed but was rather a product of the relationship between science and society (Wynne, 1992a).

Ultimately sales people recognize they have no control over the customer and cannot dictate action. The only behavior the sales person can control is their own, and while this seems a simplistic observation, it is the root of accountability for results. In the same way, scientists may improve their normative impact by recognizing that the scientific facts do not dictate policy outcomes, and that public rejection of scientists' recommendations is not a rejection of the underlying science but a rejection of the scientists' proposals. In contentious sustainability problems such as climate change, scientists possess the prerogative and therefore the responsibility for the outcomes they seek. In this way, the accountability for results may improve the normative effectiveness for scientists who accept the burden for outcomes and ceaselessly work to achieve progress against their core purpose and vision for success.

These norms may be effective in improving results attainment for solutions oriented scientists, for example in considering customer feedback to develop plausible proposals. Climate scientists have understood for about thirty years the depth of GHG emissions reductions that are required just to stabilize atmospheric carbon dioxide (Broecker, 2013). The 1990 FAR SPM claimed the reduction necessary for stabilization was sixty percent (IPCC, 1990b) and in 2010 Broecker thought it to be eighty-five percent (Broecker, 2010). These numbers are breathtaking considering the suggested cuts are essentially in the use of fossil energy.

The linkage between global warming and GHG emissions is probably undeniable, yet without a substitute for fossil energy these reductions are not plausible and if that was not apparent from the beginning then it might have become clear in the consistent practical rejection of the idea by global societies that have steadfastly refused to cut energy use in numbers remotely close to those required. A good sales person may not have recognized the proposal as implausible in advance but they would have quickly understood its rejection and set about developing new ideas. They would have understood that they could not return repeatedly with a failed proposal, the customer would not entertain it and it would damage the credibility of the sales person. Any of the other norms might apply as well but the last one certainly does and it is the most important: commitment to results.

In the best sense of trans-disciplinarity a good sales person will learn new skills, and exhaust every resource to find a way to convince the customer to accept their proposal. Climate change may be the most threatening and complex problem facing humanity and it is laudable that scientists have shouldered the burden of solving it. Sustainability scholars and scientists have recognized the transdisciplinary demands for solving wicked problems like climate change and scoured other disciplines for helpful knowledge. Results oriented management and the norms of B2B salesmanship have a great deal to contribute to organizations and individuals that are challenged with and committed to producing measurable results.

Final Comments

Sustainability scientists that are solution focused may attain improved results if they decide that beyond the verifiable, they may attempt to advocate in some way. They may maintain their science as credible because it is verifiable, and in other discourse; focus on improving their advocacy skills. Some scientists may have to overcome negative connotations with business practices but there is an enormous trove of knowledge covering ROM, strategic planning, and effective salesmanship and much of it will be helpful to those interested in planning, organizing, and managing for results in the context of sustainability.

I proposed a broadly expansive definition for advocacy that leaves a very narrow space for the neutral and objective, and thus credible. I believe this concept to be useful for sustainability scientists to better prepare them for advocacy when they engage in it. My analysis of the 2013 IPCC SPM revealed that under this definition, factual passages had tripled in number from the 1990 report and this had the effect of improving the overall credibility of the report in my view. Furthermore, the strict definition for the factual lent those passages the strength of verifiability that could better withstand challenges. It seemed useful therefore to contemplate establishing and guarding a careful distinction between the purely factual and the subjective as a means to both protect the credibility of science and to facilitate advocacy. There may be potential in this idea but it needs further development.

For the purposes of this dissertation, the strict conception of advocacy is useful to improve the awareness of sustainability scientists of the likelihood that they may overlay their empirical science with subjective representations and thereby slip seamlessly in to advocacy with the attendant credibility problems and the conflict with some of the social norms of science. Scientists who are aware of this likelihood may then take action to protect the integrity of their science and improve the effectiveness of their advocacy for the solutions they develop.

This dissertation has exposed unresolved tension between the social norms of science and the persuasive demands of the normative role in sustainability. I did not propose to resolve this problem, nor do I think that I have, but I ultimately proposed an approach that may permit scientists or their organizations to maintain the credibility of their science, while advocating for the solutions that they develop. Some scholars and some of the CCC professionals that I interviewed proposed that science and advocacy be somehow kept separate and the idea may have potential for resolving this dilemma. At the very least, this dissertation can serve as a way to open a discussion rather than come to closure on the subject.

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APPENDIX A

IRB APPROVAL

INFORMATION LETTER-INTERVIEWS
For professional climate science communicators

"Communicating Climate Science"

Date: June 5th, 2013

My name is Scott McClintock, I am a PhD Candidate under the direction of Drs. Nalini Chhetri and Sander van der Leeuw in the School of Sustainability at Arizona State University. I am conducting a research study to determine the characteristics of present climate science communication by professionals to the public and policy-makers.

I am inviting your participation, which will involve a structured interview that will take approximately 45-minutes and can be done by phone, Skype, or in person. Questions will relate to your experience and views about climate science communication and will be used to frame my dissertation research. There are no foreseeable risks or discomforts to your participation. You must be 18 years old to participate.

Your participation in this study is voluntary. You have the right not to answer any question, and to stop the interview at any time. I would like to audiotape this interview. You will not be recorded, unless you give permission. If you give permission to be taped, you have the right to ask for the recording to be stopped at any time. The recordings will be kept digitally in my research files, only long enough to complete the study at which time they will be erased.

Identities of participants will be kept confidential at all times. The results of this research will be analyzed to identify common themes, trends, and challenges and may be used in reports, presentations, or publications but your identity will not be divulged in any case.

This is important work given the risks of climate change and the challenges of conveying those risks to the public and policy-makers. Although there may be no benefit to you personally, possible benefits of your participation include a better understanding of the challenges involved in climate science communication which can lead to better strategies for future communication.

If you have any questions concerning the research study, please contact the research team at:

Global Institute of Sustainability
Arizona State University
PO Box 875402
Tempe, AZ 85287
Mail code 5402

Principal investigator: Dr Nalini Chhetri 480-965-3099
Nalini.chhetri@asu.edu
Co-investigator: PhD Candidate, Scott McClintock 480-231-0959
Scott.mcclintock@asu.edu

If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788. Please let me know if you wish to be part of the study.

Thank you,

Scott McClintock
PhD Candidate
School of Sustainability
Arizona State University

APPENDIX B

OUTLINE FOR STRUCTURED INTERVIEWS

Outline for Structured Interviews

Professional Climate Science Communicators

Dissertation research: “Climate Science Communication”
Principal Investigator: Dr Nalini Chhetri
Co-investigator: Scott McClintock
The goal of these interviews is to record the experiences and views of working professionals that are involved in climate science communication.

1. I’d like to ask you a few questions about your experiences and views regarding climate science communication. I will maintain strict confidentiality; your identity will not be divulged in any case. Do I have your permission to record this interview?
2. Tell me about yourself.
    a. How did you become involved in climate science communication?
    b. Why do you care about climate science communication?
    c. What is your present job and how does it involve climate science communication?
    d. Describe a remarkable or defining experience in climate science communication.
3. In your view, what is climate science communication?
    a. Who is the audience?
    b. Why do they matter?
    c. What is the goal of climate science communication?
    d. What media is used?
    e. What have been the results of your experience in climate science communication?
4. What are the challenges?
    a. Of handling scientific uncertainty?
    b. Of educating the public and policy-makers?
    c. Of communicating risk?
    d. Of recommending policy, or social change?
5. What Lessons have been learned?
    a. About scientific objectivity and neutrality?
    b. About scientific credibility?
    c. About audiences?
    d. About competing voices?

6. What is the future direction of climate science communication?
    a. What is the danger of the present course, if any?
    b. What changes would you recommend, if any?
    c. Do you have any other thoughts or experiences you'd like to share?

APPENDIX C

CODE STRUCTURE FOR IPCC REPORTS

CODE STRUCTURE FOR IPCC REPORTS

Atlas.ti code report: All current codes

HU: Chapter 5
File: [G:\Chapter 5.hpr7]
Edited by: Scott McClintock

Advocacy
Created: 2014-10-14 21:15:35
Modified: 2014-12-12 17:33:47

Quotations: 230
Comment:
Statements that are any combination of Controversial, Judgment, Linked to Mitigation Policy, Normative, Opinion, or Value-Based.

Controversial
Created: 2014-10-12 12:31:40
Modified: 2014-12-12 17:30:04

Quotations: 179
Comment:
Subject matter that has become publicly controversial, such as the human attribution to climate change. While there is little doubt in the scientific community that the human use of fossil fuels contributes to global warming, this has been challenged (as rationale for supporting climate change mitigation) by opponents of the scientific consensus, and it remains controversial. Arguments for human attribution are aligned with the need for mitigation policy and therefore tantamount to advocacy for it. The basis for this code is the scholarly view that when scientists engage in a controversial matter they will unavoidably align with and advocate for one side in the debate or the other. The scientific community may already view human attribution as a scientific fact but that alone does not prevent the matter from remaining controversial, resulting in scientists unintentionally advocating (AAAS, 2012; Sarewitz, 2012). Thus some sections were coded factual and controversial.

Factual

Created: 2014-10-12 13:17:21
Modified: 2014-12-12 17:34:29

Quotations: 85
Comment:

Statements citing facts and adhering to facts. A fact is something that has actually happened, or is actually the case. This would include uncertainty qualifiers when they truthfully reflect the scientists' level of confidence in the related statement. Facts are verifiable which in science requires repeatability. Examples in this analysis include temperature observations, proven or broadly accepted scientific understandings of the natural world such as the greenhouse effect.

Judgment
Created: 2014-10-12 12:33:02
Modified: 2014-12-12 17:31:32

Quotations: 198
Comment:

Statements drawing a conclusion. For example: "Continuation of present day emissions are committing us to increased future concentrations, and the longer emissions continue to increase, the greater would reductions have to be to stabilize at a given level" (IPCC, 1990b, p. XVII). These judgments align with the scientific consensus on climate change and to advocacy for mitigation.

Linked to mitigation policy
Created: 2014-10-12 12:36:33
Modified: 2014-12-12 17:31:38

Quotations: 101
Comment:

Statements about scientific findings and assessments that are linked to the prevailing global policy initiative to reduce greenhouse gas emissions. For example: References to human attribution implies the need for mitigation.

Normative
Created: 2014-10-12 12:30:06
Modified: 2014-12-12 17:30:25

Quotations: 25

Comment:

Statements expressing a prescription. For example: “Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions” (IPCC, 2013c, p. 19). Such statements argue for a course of action and are advocacy for it.

Opinion
Created: 2014-10-12 12:32:17
Modified: 2014-12-12 17:31:08

Quotations: 196
Comment:

Statements revealing a belief or way of thinking about something. Some examples include: “The long-lived gases would require immediate reductions in emissions from human activities of over 60% to stabilize their concentrations at today's levels… Carbon dioxide has been responsible for over half the enhanced greenhouse effect in the past, and is likely to remain so in the future ” (IPCC, 1990b, p. XI). Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia (IPCC, 2013c, p. 4). Human influence on the climate system is clear” (IPCC, 2013c, p. 15). These statements of opinion align the reports with the scientific consensus on climate change and to advocacy for mitigation.

Strictly Factual
Created: 2014-10-14 20:55:10
Modified: 2014-12-12 17:34:58

Quotations: 57
Super Code Search Term: NOT ((((("Controversial" | "Judgment") | "Linked to mitigation policy") | "Normative") | "Opinion") | "Value based")
Comment:

Coded only factual, no other codes applied.

Value based
Created: 2014-10-12 12:30:38
Modified: 2015-1-31 17:30:49

Quotations: 104
Comment:

A statement of the desirability of something. For example: “Business-as-Usual emissions will make global mean temperatures higher than they have been in the last 150,000 years” (IPCC, 1990b, p. XXVIII). Such statements in IPCC reports frequently imply that something is undesirable and represent the attempt to persuade. Other examples discuss flooding, ocean acidification, or interference with the ecosystem for example, in ways that characterize the subject's (un)desirability. This code identifies statements that reveal information about what the authors value by what they deem undesirable and/or desirable. If the authors did not value the subject in question then they would be ambivalent about outcomes and would not reveal preferences. Many scholars assert that scientists' values permeate their work from the selection of their research to the interpretations of their research results and this coding reflects that. These statements are rarely explicit expressions of value and yet they reveal the authors' preferences for certain outcomes over others. For example, the authors generally argue that climate impacts are negative and they prefer sacrificial mitigation in the present despite its costs to others who value present economic well-being more than the authors. It is emblematic that many countries in climate negotiation have favored their near-term economic well-being to the mitigation levels proposed by scientists. These values revealed by IPCC authors are not universal or comprehensive and thus these statements are an intent to persuade the audience of the authors' value based reasoning. Typically these coded statements are a continuation or a component of a larger value based argument made by IPCC authors. Passages coded as value based effectively argue the desirability of something. For example; ocean acidification bears a negative connotation that implies undesirability. The same material could be covered by providing numeric pH data which would not bear the connotation of the word acidification. In another example, human attribution to climate change is inherently critical of human activity, which is not a universal value and represents the effort of the authors to persuade the audience of a select value system.

Explicit Values

Created: 2015-1-27 13:38:13
Modified: 2015-1-31 19:46:58

Quotations: 12
Comment:

Statements that explicitly express the desirability of something.

APPENDIX D

CODE STRUCTURE FOR INTERVIEWS

CODE STRUCTURE FOR INTERVIEWS

Atlas.ti code report: All current codes

HU: Chapter 6
File: [C:\Documents and Settings\All Users\Documents\Scott's Docum...\McClintock Dissertation.hpr7]
Edited by: Scott McClintick
Date/Time: 2014-07-30 16:16:56

ADV_can't_separate_science_from_policy
Created: 2014-02-26 10:15:33
Modified: 2014-07-30 16:09:24

Families (1): ADVOCACY
Quotations: 5
Comment:
Arguments that it's difficult to discuss science and the problems that scientific discovery expose without also discussing solutions to those problems.

ADV_defined
Created: 2014-02-26 09:42:27
Modified: 2014-07-10 20:26:07

Families (1): ADVOCACY
Quotations: 19
Comment:
Definitions of advocacy.

ADV_don't_by_our_definition
Created: 2014-02-26 09:43:15
Modified: 2014-07-10 20:24:02

Families (1): ADVOCACY
Quotations: 12
Comment:
Interviewees who claimed they do not advocate because what they are doing is not advocating in their view.

ADV_how_to
Created: 2014-02-26 09:48:53
Modified: 2014-02-26 12:49:31

Families (1): ADVOCACY
Quotations: 7
Comment:
Thoughts on how advocacy should best be done.

ADV_may_do_so
Created: 2014-01-18 16:33:27
Modified: 2014-07-30 16:09:43

Families (1): ADVOCACY
Quotations: 9
Comment:
Arguments that advocacy is the scientist's prerogative; they may do so if they wish.

ADV_obligation_to_the_public
Created: 2014-01-15 16:07:16
Modified: 2014-02-26 10:35:58

Families (1): ADVOCACY
Quotations: 7
Comment:
Arguments that because they are publicly funded, scientists have an obligation to advocate for changes that would mitigate the risks to society that scientists discover in the course of their work.

ADV_separate_advocacy_from_science
Created: 2014-01-15 15:58:46
Modified: 2014-07-10 20:28:18

Families (1): ADVOCACY
Quotations: 22
Comment:
Arguments that advocacy and science are different activities and must be kept separate.

ADV_should
Created: 2014-01-16 11:36:26
Modified: 2014-07-30 16:10:23

Families (1): ADVOCACY
Quotations: 21
Comment:
Arguments that scientists should advocate; they have a moral obligation to warn society of danger they discover through their research and to promote solutions.

ADV_should_not
Created: 2014-01-18 16:31:26
Modified: 2014-07-10 14:10:23

Families (1): ADVOCACY
Quotations: 18
Comment:
Arguments that scientists should NOT advocate; they should remain neutral and objective in order to maintain their scientific credibility.

CHAL_personal_experience
Created: 2014-01-15 15:36:47
Modified: 2014-03-11 15:20:38

Families (1): CHALLENGE OF CLIMATE SCIENCE
Quotations: 10
Comment:
Arguments that people respond more easily to things that they can experience, like weather, or events that are closer to home; heat waves, cold spells storms, etc.

CHAL_public_opinion
Created: 2014-01-16 19:26:05
Modified: 2014-03-03 16:54:09

Families (1): CHALLENGE OF CLIMATE SCIENCE
Quotations: 8
Comment:
Comments on public opinion on the possibility of taking policy action on climate change.

CHAL_scale_complexity_of_problem
Created: 2014-03-03 15:28:05
Modified: 2014-03-03 15:37:29

Families (1): CHALLENGE OF CLIMATE SCIENCE
Quotations: 8
Comment:
Comments that the scale and complexity of climate change creates problems for people to understand and accept the science.

COMM_audience_journalists
Created: 2014-03-19 09:33:08
Modified: 2014-07-30 16:11:51

Families (1): AUDIENCE
Quotations: 6
Comment:
Arguments that journalists are an important audience.

COMM_audience_policy-makers
Created: 2014-03-12 16:20:51
Modified: 2014-07-30 16:12:06

Families (1): AUDIENCE
Quotations: 10
Comment:
Arguments that policy-makers are an important audience.

COMM_audience_public
Created: 2014-03-12 16:49:35
Modified: 2014-07-30 16:12:18

Families (1): AUDIENCE
Quotations: 25
Comment:
Arguments that the public is an important audience.

COMM_audience_scientists
Created: 2014-03-19 09:18:38
Modified: 2014-07-30 16:12:33

Families (1): AUDIENCE
Quotations: 6
Comment:
Arguments that scientists are an important audience.

COMM_audience_teachers_students
Created: 2014-03-19 09:15:56
Modified: 2014-07-30 16:12:53

Families (1): AUDIENCE
Quotations: 10
Comment:
Arguments that academia is an important audience.

COMM_CCC_ future
Created: 2014-01-15 13:56:46
Modified: 2014-03-04 12:22:45

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 27
Comment:
Comments about where CCC is headed in the future and where it should be headed.

COMM_CCC_goal
Created: 2014-01-15 12:28:29
Modified: 2014-01-24 09:22:45

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 12
Comment:
Answer to: what is your goal in CCC?

COMM_debunk_myths
Created: 2014-01-18 10:12:10
Modified: 2014-02-27 13:19:48

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 5
Comment:
Ideas for dealing with mis-information in climate science.

COMM_deficit_model
Created: 2014-01-15 15:07:44
Modified: 2014-03-11 15:15:39

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 4
Comment:
Comments about the deficit model of public understanding of science.

COMM_ethics
Created: 2014-01-16 10:27:08
Modified: 2014-07-30 16:13:18

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 8
Comment:
Comments about the ethics of CCC

COMM_is_different_from_science
Created: 2014-01-16 10:16:11
Modified: 2014-07-30 16:13:28

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 8
Comment:
Arguments that CCC and science are essentially different activities that require different skills.

COMM_just_the_sceince
Created: 2014-01-15 14:19:46
Modified: 2014-07-10 20:28:18

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 16
Comment:
Comments about adhereing to the facts in the science.

COMM_knowledge_from other disciplines
Created: 2014-01-15 15:19:37
Modified: 2014-02-27 17:57:42

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 24
Comment:
Comments about using knowledge from other disciplines in CCC

COMM_no_budget_for_CCC
Created: 2014-01-15 14:10:24
Modified: 2014-07-30 16:13:55

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 4
Comment:
Comments about the lack of planning or budgeting for CCC

COMM_opposing_voices
Created: 2014-01-18 10:14:49
Modified: 2014-03-31 03:21:55

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 76
Comment:
*** Merged Comment from: COMM_Opposing_ views (2014-01-21T08:55:42) ***
Comments about those who oppose the consensus scientific view on climate change.

COMM_politics
Created: 2014-01-16 19:28:28 by Super
Modified: 2014-03-25 14:29:09

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 14
Comment:
*** Merged Comment from: POLITICAL not scientific (2014-01-21T08:48:13) ***
Comments about CCC being a political problem, not a scientific problem.

COMM_results
Created: 2014-01-15 12:25:49
Modified: 2014-02-27 14:10:57

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 32

Comment:
Describes what results the interviewee has observed from their CCC.

COMM_risk
Created: 2014-01-15 14:56:11
Modified: 2014-07-30 16:14:28

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 18
Comment:
Comments about risk framing,

COMM_scientists_do_poorly
Created: 2014-01-15 15:17:49
Modified: 2014-05-15 03:48:30

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 45
Comment:
Comments about scientists being poor communicators.

COMM_scientists_do_well
Created: 2014-01-15 15:34:33
Modified: 2014-02-26 10:41:11

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 6
Comment:
Comments about scientists being good communicators.

COMM_tactics
Created: 2014-01-18 09:55:05
Modified: 2014-05-06 16:20:37

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 71
Comment:
Comments about tactics that are useful in CCC.

COMM_translate_into_English
Created: 2014-01-15 15:03:16
Modified: 2014-07-30 16:14:56

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 20
Comment:
Comments about translating climate science into usable language, plain English.

COMM_uncertainty
Created: 2014-01-15 12:29:09
Modified: 2014-07-30 16:15:04

Families (1): CLIMATE CHANGE COMMUNICATION
Quotations: 45
Comment:
Comments about scientific uncertainty.

COMM_who_audience
Created: 2014-01-15 12:24:59
Modified: 2014-03-22 17:41:36

Families (1): AUDIENCE
Quotations: 34
Comment:
Answer to: Who is your audience in CCC?

COMM_why_audience
Created: 2014-01-15 14:14:34
Modified: 2014-03-22 17:12:15

Families (1): AUDIENCE
Quotations: 22
Comment:
Answer to: Why does the CCC audience matter?

INDIV background
Created: 2014-01-15 12:17:41
Modified: 2014-03-04 13:10:15

Families (1): INDIVIDUAL INFORMATION

Quotations: 30
Comment:
Describes the background of the individual being interviewed.

INDIV_interest_in_CCC
Created: 2014-01-15 12:23:58
Modified: 2014-03-04 14:25:03

Families (1): INDIVIDUAL INFORMATION
Quotations: 27
Comment:
Describes the inteviewee's interest in CCC

INDIV_non_ scientist
Created: 2014-01-15 12:31:52
Modified: 2014-03-04 09:49:41

Families (1): INDIVIDUAL INFORMATION
Quotations: 13
Comment:
Describes the interviewee as a non-scientist.

INDIV_pivotal_event
Created: 2014-01-16 09:33:04
Modified: 2014-02-27 17:34:17

Families (1): INDIVIDUAL INFORMATION
Quotations: 24
Comment:
Description of a pivotal event that changed the interviewee's views on climate change and drove them into the subject.

INDIV_scientist
Created: 2014-01-16 19:18:25
Modified: 2014-03-04 13:10:15

Families (1): INDIVIDUAL INFORMATION
Quotations: 10
Comment:
Information that describes the interviewee as a scientist.

MED_MEDIA
Created: 2014-01-15 14:17:43
Modified: 2014-02-27 13:42:22

Families (1): MEDIA
Quotations: 23
Comment:
Comments about media used in CCC

MEDI_balanced_reporting
Created: 2014-01-16 10:09:46
Modified: 2014-03-03 15:22:16

Families (1): MEDIA
Quotations: 7
Comment:
Comments about balanced reporting about climate change. US media tend to offer both sides to the story even when one side may be heavily favored. In climate science, this gives readers the impression that climate science is still heavily debated when in fact most climate scientists share the same fundamental perspective.

SCIENCE_credibility
Created: 2014-01-15 14:01:05
Modified: 2014-07-30 16:03:41

Families (1): SCIENCE
Quotations: 45
Comment:
Comments about scientific credibility.

SCIENCE_groupthink
Created: 2014-01-18 10:20:03
Modified: 2014-02-27 14:29:12

Families (1): SCIENCE
Quotations: 7
Comment:
Comments about the possible resistance of mainstream scientists to non-mainstream views, or discoveries that may challenge the mainstream climate science.

SCIENCE_objective_neutral
Created: 2014-01-16 11:35:29
Modified: 2014-07-30 16:16:29

Families (1): SCIENCE
Quotations: 14
Comment:
Relating to scientific objectivity and neutrality.

BIOGRAPHICAL SKETCH

Scott McClintock received a BA in Business Administration from Olivet Nazarene University in Kankakee, Illinois, and commenced a more than two-decade career in sales management, rising to the level of Vice President, with accountability for more than $200 million in annual revenue and the responsibility for a large organization. During this time the he studied for and earned a MBA in Strategy and Leadership from Roosevelt University in Chicago.

With retirement, McClintock finished a degree in Marine Engineering and Small Boat Design and opened his own design studio, securing a U.S. Patent and producing several innovative designs. The 2008 economic downturn forced a decision to scale the business back and McClintock chose to pursue a Ph.D. at the School of Sustainability at Arizona State University. Within weeks of enrolment, McClintock became fascinated with the unmet challenges of persuasion for sustainability scientists and the rest is in this dissertation.