THE **LONDON SCHOOL**
OF **ECONOMICS** AND
POLITICAL SCIENCE ■

Climate change as a knowledge controversy:
Investigating debates over science and policy

Amelia Sharman

A thesis submitted to the Department of Geography and Environment of the London School of Economics and Political Science for the degree of Doctor of Philosophy, London, September 2015

Declaration

I certify that the thesis I have presented for examination for the PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

The copyright of this thesis rests with the author. Quotation from it is permitted, provided that full acknowledgement is made. This thesis may not be reproduced without the prior written consent of the author.

I warrant that this authorisation does not, to the best of my belief, infringe the rights of any third party.

I declare that my thesis consists of 77,072 words.

Statement of conjoint work

I confirm that Chapters 4 and 5 were jointly co-authored with Dr Candice Howarth and I contributed 50% of this work. I confirm that Chapter 7 was jointly co-authored with Dr Richard Perkins and I contributed 50% of this work.

Abstract

Understanding climate change as a knowledge controversy, this thesis provides new insights into the form, value and impact of the climate change debate on science and policy processes. Based on 99 interviews in New Zealand and the United Kingdom as well as social network analysis, it provides an original contribution to knowledge by identifying previously unknown sites of knowledge contestation within the climate change debate, in addition to contributory factors, and potential solutions to, debate polarisation. It also addresses a fundamental gap in the literature regarding the impact of controversy on the production of scientific knowledge and policy decision-making.

This thesis comprises five standalone papers (Chapters 2-6) which together explore climate change as a knowledge controversy using frameworks from science and technology studies, sociology and geography. Chapter 2 finds that the most central blogs within the climate sceptical blogosphere predominantly focus on the scientific element of the climate debate. It argues that by acting as an alternative public site of expertise, the blogosphere may be playing a central role in perpetuating doubt regarding the scientific basis for climate change policymaking. Chapter 3 suggests that the binary and dualistic format of labels used within the climate debate such as "denier" or "alarmist" contribute towards polarisation by reducing possibilities for constructive dialogue. Chapter 4 investigates rationales for debate participation and argues that identifying and emphasising commonalities between previously polarised individuals may serve to reduce antagonism within the climate change debate. Chapter 5 investigates the impact of controversy on the production of scientific knowledge and finds that climate scientists identify substantial impacts on their agency as scientists, but not on scientific practice. It argues that this distinction indicates that boundary-making may be understood as a more active and explicit process under conditions of controversy. Finally, Chapter 6 introduces the concept of post-decisional logics of inaction, emphasising the role of place in determining the influence of controversial knowledge claims on climate change policymaking.

These findings make explicit the underlying politics of knowledge inherent within the climate change debate, and emphasise the need for a more attentive consideration of the role of knowledge, place and performativity in contested science and policy environments.

Acknowledgements

This thesis would not exist without my excellent supervisor Richard Perkins, who has been incredibly supportive, both academically and personally, throughout the entire PhD process—I could not have asked for a better supervisor. I am tremendously and sincerely grateful for all the effort you put into me and my work. Thank you also to Michael Mason, my review supervisor, and the other staff members from the Department of Geography and Environment and the Grantham Research Institute on Climate Change and the Environment (GRI) for your insightful questions, advice and comments on my research. I would also like to take this opportunity to thank my viva examiners, Professor David Demeritt and Professor Reiner Grundmann, for their helpful comments and suggestions.

Thank you to Candice Howarth—while wrestling our papers into submission took some time, it was invaluable to learn exactly what it means to co-author and it has done my planning and project management skills no end of good. Hopefully there will be many more such occasions in the future.

I am extremely thankful to all those who participated in this research, either as interviewees or those who helped me access relevant resources and information, as without their generous donations of time and willingness to talk, much of this research would not have been possible. The insightful comments and suggestions from the anonymous reviewers who generously gave their time to improve the papers submitted for external peer review as part of this thesis are also very gratefully acknowledged. The changes were invariably for the better and were extremely useful in honing my writing over the course of the PhD.

Thank you to LSE for granting me an LSE PhD Scholarship, without which I would not have been able to carry out this research. Financial and other support from the Department of Geography and Environment, GRI, and the Research and Development Management Association is also very gratefully acknowledged.

To all my fellow GRI PhD students and staff—there could not have been a lovelier group of people with whom to spend four years. I have made some true friendships and will always look back on my time at GRI with real affection. Thank you for being academically encouraging, but also bringing such a sense of fun and camaraderie to work every day.

Thank you to the wonderful people involved with LSE Bees. Caring for our bees was the perfect antidote to any stressful PhD moments and along with everything I have learned academically while at LSE, learning the value of, and how to care for bees is something I will take with me forever.

I am eternally thankful to my parents, Christine and Geoff. Your unwavering support for my education has been invaluable for getting me to where I am today and there is no way I could have achieved this goal without your love and guidance.

Finally, and most especially, thank you to my husband Adrian. Your constant encouragement and love has been fundamental to making this PhD a reality. You cracked the whip and kept me on the straight and narrow (who knows what I could achieve with an nth of your self-discipline!) but were also so supportive and I knew that you were there with me every step of the way.

Any remaining errors remain solely and entirely my own.

Table of contents

List of tables

List of figures

List of frequently used abbreviations

CCA	Climate Change Act 2008
CS	Climate scientist
GHG	Greenhouse gas(es)
GWPF	Global Warming Policy Foundation
IPCC	Intergovernmental Panel on Climate Change
NIWA	National Institute of Water and Atmospheric Research
NZ	New Zealand
NZCSC	New Zealand Climate Science Coalition
NZCSET	New Zealand Climate Science Education Trust
NZ-ETS	New Zealand Emissions Trading Scheme
SNA	Social network analysis
SSK	Sociology of scientific knowledge
STS	Science and technology studies
SV	Sceptical voice
UK	United Kingdom
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America

Chapter 1. Introduction

1.1 Introduction

More often than not, science produces more questions than answers. This is an innate characteristic of scientific endeavour as a whole, the goal of which is to seek 'insight and knowledge about nature through an ongoing process of questioning, hypothesizing, validation, and refutation' (Sarewitz, 2000: 84). As science is carried out, new research questions continually emerge, creating an ever-increasing web of potential avenues for examination—as well as concomitant possibilities for dispute between scientific actors. These disputes, or scientific controversies, may erupt at any point in the research process (Pinch, 2001), but are also able to transcend the confines of academia and influence public decision-making (Martin and Richards, 1995). These, now public, scientific controversies involving both science and policy are likely when the issue in question is at the cutting edge of research endeavour and either where social values are unclear, such as the use of genetically modified organisms outside controlled laboratory environments (Lacey, 2015), or where it is of significant interest to the wider, non-scientific, community, such as alcohol consumption or vaccination policy (Martin, 2014; Naylor et al., 2014; Veselková, 2014). In such cases, scientific, and other, evidence is gathered by participants to support their position or intended policy outcome (Roosth and Silbey, 2009; Pfister and Horvath, 2014). Yet this assemblage of evidence is not always straightforward as actors dispute the legitimacy of claims and their authority in public decision-making.

Within the geography and sociology literatures, a strong tradition has been established examining public scientific controversies in the environmental realm. Whatmore (2009: 588) defines these as 'events in which the knowledge claims and technologies of environmental science, and the regulatory and policy practices of government agencies that they inform, become subject to public interrogation and dispute'. Whatmore's definition is particularly pertinent as it foregrounds the notion of knowledge. Following Martin and Richards (1995), Nowotny et al. (2001), Sarewitz (2004), Collins (2014) and others, this thesis argues that disputes over knowledge are a defining feature of public scientific controversies. A knowledge controversy is understood here as a situation whereby conflicting knowledge claims and valuations of evidence and expertise are assembled to support different points of view within contentious public debate. This definition extends the notion of public scientific controversy as it

recognises that whereas scientific claims may be frequently employed in contentious situations, claims based on other types of knowledge, such as debates regarding the likely economic consequences of a policy choice, may also enter into and be influential in particular contexts. It further extends Whatmore's definition by explicitly highlighting the knowledge-related elements of controversy, specifically the assemblage of knowledge claims, and the different authority and legitimacy that is accorded to evidence and expertise.

Climate change is a knowledge controversy of unprecedented global significance. Not only is the scientific basis of climate change vigorously disputed, both in terms of its reality and severity (Reddy and Assenza, 2009; Schmidt, 2010; Hoffman, 2011a; Capstick and Pidgeon, 2013; Kane, 2013), but more policy-based or politically-oriented factors are also debated, such as the necessity of carbon taxes or other regulatory mechanisms (Kelly, 2010; Boykoff and Olson, 2013; Lockwood, 2013; Martin and Rice, 2014). Policy-focused contestation is not unexpected, particularly given the behavioural or cost implications of certain types of climate change policies (Stoll-Kleemann et al., 2001; Whitmarsh, 2009; Fudge and Peters, 2011). Science-based disagreement is also well-documented, whereby framings such as "sound" science versus "junk" science (McCright and Dunlap, 2003; McGarity, 2003-2004) are employed in what Latour (1987) refers to as "trials of strength"; pitting evidence against evidence in battles of cognitive legitimacy. Knowledge controversy is therefore also fundamentally about *whose* evidence, opinions, arguments and framings are influential—*whose* politics and science come to have authority within a contested domain. But despite recognition that science and policy contestation *exists* in the context of climate change, much less is known about its form, value and, especially, impact. Climate change is a particularly enlightening case study with which to examine these aspects of knowledge controversy because of its nature as a problem of such "wicked" complexity (Rittel and Webber, 1973) that is exceptional in terms of scale, uncertainty and international relevance. Whilst it has some similarities to previous scientific controversies, such as the relationship between chlorofluorocarbons and atmospheric ozone degradation in the 1980s, including the existence of outspoken scientists who were supported by authoritative scientific and media institutions (Grundmann, 2009), several key differences exist. Below (2008: 2) shows that not only was the underlying science of ozone degradation 'largely conclusive and universally accepted' but that crucially, 'alternatives to ozone depleting substances had already been developed and were ready to use' (Below, 2008: 2). In the case of climate change,

scientific contestation remains visible despite decades of scientific enquiry, and its dispersed and interconnected nature means that no "silver bullet" solution is available.

The next section presents the overarching motivation for this thesis, and is followed by an outline of the research aims and thesis structure. An explanation of the format of this thesis is provided in Section 1.3, followed by a brief conclusion.

1.1.1 Research motivation

Hoffman (2011b: 4) argues that the climate change debate, specifically the perspectives and logics of those who challenge consensus framings, has been subject to 'significant oversight' on behalf of social science researchers. While the majority, particularly those within academic or political circles (Bolsen et al., 2015) consider that climate change exists and is predominantly anthropogenic in origin (see however Unsworth and Fielding (2014) for an interesting discussion of the salience of political beliefs and climate change opinion), a small, yet often vocal minority challenges this viewpoint. Hoffman contends that social science does 'not yet have a framework to talk about the climate debate in the social realm' and calls for 'more social science research on the conflict over climate change at the individual and organizational levels of analysis' (2011b: 5). This thesis thus directly responds to this call for action to better understand not only the nature of the 'logic schism' (2011b: 5) evident within the climate change debate, but also its impact on processes of science and policy using the paradigm of knowledge controversy.

This research was also initially motivated by curiosity regarding how decisions are made about climate change within the context of contentious public debate. If, as Rayner (2009: xxiii) argues, 'debate around climate has succeeded debate around capital and social class as the organising theme of political discourse in contemporary society', understanding more about the nature of this contestation as well as its influence in society is critical. While the notion of scientific controversy more generally was an original guiding framework, what became apparent as research progressed was the central theme of knowledge as a critical element of the climate change debate, including fascinating questions regarding the instrumental use of knowledge claims within debates over science and policy, as well as how different individuals were positioned (or positioned themselves) as experts in order to hold cognitive legitimacy within contested domains.

Climate change has long been recognised as a "post-normal" problem (Funtowicz and Ravetz, 1993; Lorenzoni et al., 2007), with climate scientists, policy officials, politicians and other actors drawn into a debate that is not just about technical data and its myriad interpretations, but one which is also fundamentally about how knowledge claims interact with worldviews, risk perceptions and values (Demeritt, 2000; Leiserowitz, 2006; Douglas, 2009; Hulme, 2009; Douglas, 2015; Tangney and Howes, 2015). Indeed, Demeritt (2006: 472) identifies a critical paradox whereby a neat separation between objective facts and contestable values is idealised in the context of climate change, whilst in parallel it is 'habitually breached in ordinary practice'. This research therefore builds on more social constructionist ideas of knowledge (Pinch and Bijker, 1984; Rayner, 2012) that recognise that controversy is not about 'an absence of certainty, but rather of *contradictory certainties*: several divergent and mutually irreconcilable sets of convictions both about the difficulties we face and the available solutions' (Hannigan, 2006: 29, emphasis in the original). In so doing, it recognises both the explicit (such as the arguments expressed) and latent (such as the rationales and values that underpin opinions) elements at play within the climate change debate, as well as highlighting more liminal disputes occurring at the science-policy interface.

This research is situated within a number of different academic fields, namely science and technology studies (STS), the sociology of scientific knowledge (SSK), environmental sociology and geography. It is theoretically grounded in what Collins and Evans (2002) refer to as the second wave of science studies as it is preoccupied not with what the dispute in question *is*, but how knowledge is both valued within controversial contexts and how it contributes to the formation of opinions and judgements. In so doing it continues the STS tradition of highlighting the 'co-production of scientific claims, political decisions and social order' (Grundmann, 2009: 399). It also aims to avoid the normative criticisms frequently observed as part of the climate change debate (Dunlap, 2013), and therefore does not consider or comment on the validity of the knowledge claims and opinions expressed by the actors involved.

Key issues of attention surrounding the interplay of science and policy include theories of expertise, rationales for debate engagement, and how arguments and opinions are brought to, and framed within, contentious environments (Collins and Evans, 2002; Hoppe, 2005; Demeritt, 2006; Hoffman, 2011b; Knight and Greenberg, 2011; Longino, 2013; Collins, 2014). Many of these issues, particularly definitions of expertise as well as the role of experts in society remain open topics of debate in both the broader social

science literature (Rip, 1985; Turner, 2001; Sarewitz, 2004; Stehr and Grundmann, 2011; Nisbet and Markowitz, 2014; Pfister and Horvath, 2014; Spruijt et al., 2014; Evans, 2015; Lave, 2015; Turner, 2014) as well as in research directly focused on the topic of climate change (Grundmann, 2009; Anderegg et al., 2010; Berkhout, 2010; Rehg, 2011; Beck et al., 2014; Besel et al., 2012; Hess, 2014; Shapiro, 2011; Solli and Ryghaug, 2014). As an overarching motivation, the research contained within this thesis therefore aims to contribute towards wider understandings of knowledge utilisation, value and impact within contentious situations.

1.2   Research aims and thesis structure

While specific elements of the climate change debate have been extensively analysed within the literature, such as taxonomies of arguments opposing mainstream climate science[1] and climate policy decisions (Rahmstorf, 2005; Hobson and Niemeyer, 2012), or the ways in which dispute is framed by the media (Akerlof et al., 2012; Boykoff, 2013)[2], explicit analyses of climate change as a knowledge controversy are lacking. In particular, there is limited understanding regarding the impact of contested knowledge claims on climate change science and policymaking processes, as well as the ways in which knowledge claims are both produced by, and resonate with different actors in specific contexts. At its heart therefore this research is concerned with the underlying epistemological basis of climate change (Forsyth, 2003) and examining the 'politics of knowledge' (Beck, 1992: 51; see also Grundmann and Stehr, 2003; Grundmann, 2007; Grundmann, 2013) that are inherent within the climate change debate. Such knowledge politics are defined by Grundmann and Stehr (2003: 184) as 'the use of knowledge to advance not only specific political goals and economic interests but also certain norms, values and worldviews'. Building on this conceptual framework, the overarching aim of this thesis therefore is to investigate climate change as a knowledge controversy. This aim is purposefully broad in order to respond to the nature of this thesis as a paper-based research project (see Section 1.3 below for an explanation of the format of this thesis) but prioritises the core notion of knowledge as the dominant topic of investigation.

Underneath this broad topic are myriad potential research avenues. Two sub-topics in particular however have been under-examined in the literature and are thus considered especially worthy of further attention. The first is the relationship between the form of the climate change debate and the value placed on particular knowledge

claims. While, as noted above, much of the literature examining the climate change debate has focused on the communication of arguments and opinions via the media, several gaps exist in the literature in terms of understanding more about alternative knowledge networks and how the positioning of actors within knowledge controversies not only creates identity and positioning within particular contexts, but can also influence the very nature of the controversy itself. Three individual research papers address this sub-topic. The first asks where knowledge is contested and is concerned with understanding whether the location of knowledge controversy influences the valuing of knowledge claims. The second asks how the framing of the climate change debate contributes towards knowledge contestation and is specifically interested in the discursive labels applied to individual actors within the debate. The third asks how the valuing of knowledge claims contributes towards rationales for debate participation, or whether other rationales such as underlying values or motivations may play a more critical role. The second and third papers are thus particularly interested in the specific actors and their identities within the climate change debate. Together, they are also preoccupied with the polarisation that is evident within the climate change debate and thus seek to comment on its causes and potential solutions.

The second sub-topic investigates the impact of knowledge contestation. While many attempts have been made to identify and describe the climate change debate, an important gap in the literature remains in terms of understanding how, if at all, knowledge contestation influences processes of science and policy. Two individual research papers address this sub-topic. The first explores the impact of knowledge controversy on the production of scientific knowledge, and the second investigates the impact of knowledge controversy on policy decision-making. Taken together, these two sub-topics aim to provide a multi-faceted investigation into climate change as a knowledge controversy, bringing to light issues directly relevant to climate change specifically, but also to comment more broadly and conceptually on the notion of knowledge controversy in general. The nested nature of the overarching aim, sub-topics, and specific research questions is shown in Figure 1.1.
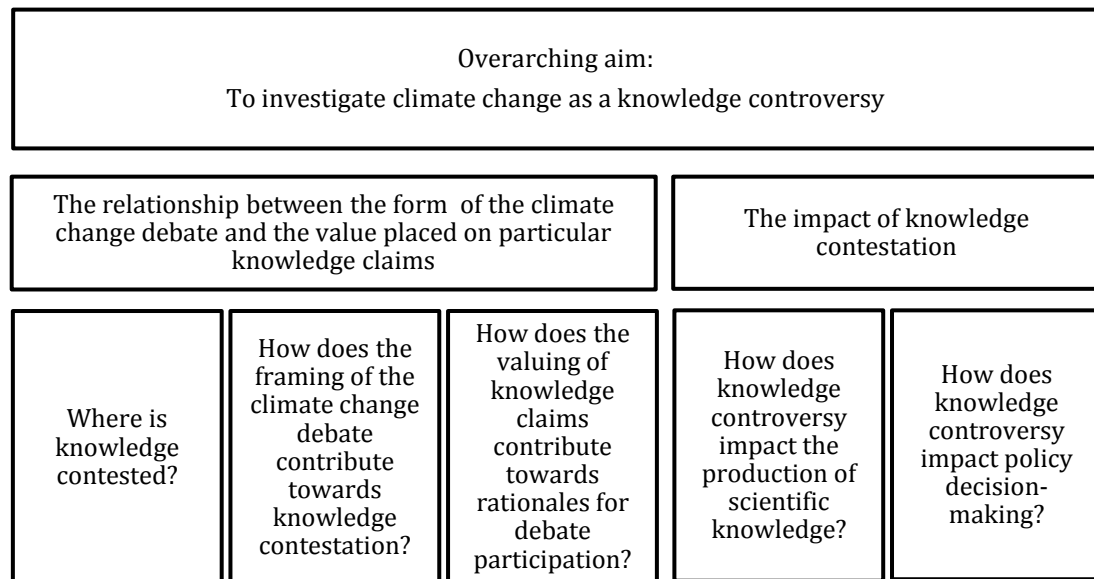
Figure 1.1: Research aims

In order to answer these research questions, this thesis is composed of seven chapters divided into four main parts (Table 1.1). Part 1 comprises this chapter and provides an introduction to, and an outline of, this thesis. It presents the analytical framework of knowledge contestation which underpins this research and discusses the original contribution to knowledge of each individual paper comprising this thesis.

Table 1.1: Thesis structure

Part	Focus	Chapter and paper title
1	Introducing this thesis and the overarching analytical framework of knowledge controversy that guides the constituent chapters	1. Introduction
2	The relationship between the form of the climate change debate and the value placed on particular knowledge claims: - Where is knowledge contested?	2. Mapping the climate sceptical blogosphere
	- How does the framing of the climate change debate contribute towards contestation?	3. Labelling opinions in the climate debate: A critical review
	- How does the valuing of knowledge claims contribute towards rationales for debate participation?	4. Climate stories: Why do climate scientists and sceptical voices participate in the climate debate?
3	The impact of knowledge contestation: - How does knowledge controversy impact the production of scientific knowledge?	5. The impact of controversy on the production of scientific knowledge
	- How does knowledge controversy impact policy decision-making?	6. Post-decisional logics of inaction: The impact of climate controversy on policy decision-making
4	Critical discussion of, and conclusion to, this thesis	7. Conclusion

Chapter 2: *Mapping the climate sceptical blogosphere*, presents the first of the five individual research papers collated together to form this thesis and focuses on understanding where knowledge is contested in the climate change debate. It identifies a gap in the literature in terms of what is known about alternative networks of scientific knowledge production, i.e. those beyond the realm of mainstream science. In the context of climate change, online sources are regarded as particularly relevant sites of alternative knowledge production (Schäfer, 2012). Accordingly, this paper identifies and critically examines the climate sceptical blogosphere and investigates whether a focus on particular themes contributes to the positioning of the most central blogs. It identifies a network of 171 individual blogs and finds that the most central blogs predominantly focus on the scientific element of the climate change debate. The paper suggests that not only is this overt scientific framing a key factor in the positioning of these central blogs, but that in so doing, they are also acting as alternative public sites of expertise for a climate sceptical audience. It is innovative methodologically in its application of social network analysis to the online climate change debate, as well as empirically by not only identifying the climate sceptical blogosphere, but also examining its role as a public site of knowledge contestation. It thus contributes directly to the nascent literature on the role of virtual spaces as key sites of alternative knowledge production as well as to wider discussions regarding the types of knowledge considered valuable within public scientific controversies.

Chapter 3: *Labelling opinions in the climate debate: A critical review*, investigates how the framing of the climate change debate contributes to debate polarisation and contestation and argues for a re-conceptualisation of how labels are used within this context. A substantial amount of academic research has been directed towards identifying and categorising different perspectives on climate change. However, a comprehensive literature review of both the form of these climate opinion labels, such as how terms including "sceptic" or "alarmist" become attributed to holders of different knowledge claims, as well as their impact in terms of framing the climate change debate, was missing from the literature. This paper identifies the existing labelling constructs presented in the academic literature, including the ways in which researchers have aimed to better understand particular categories of labels such as dividing the overarching category of climate scepticism into more detailed taxonomies, or via the use of new labels. In addition to this critical literature review, the key original contribution to knowledge provided by this paper is its assessment of the ways in which these labelling constructs, both in terms of their use in academic contexts and in

their broader use within science and policy debates, are reflecting and helping to frame the climate change debate as antagonistic and combative. It suggests that the use of and unique emphasis on labels within the climate change debate is accentuating polarisation and diverting attention away from a focus on the motivations underlying different knowledge claims which is argued to be more conducive towards encouraging constructive dialogue.

Chapter 4: *Climate stories: Why do climate scientists and sceptical voices participate in the climate debate?*, investigates how the valuing of knowledge claims contributes towards rationales for debate participation. It presents results from 22 interviews with climate scientists and sceptical voices[3] on their experience within the climate change debate. It is empirically novel as it actively includes the direct perspectives of sceptical voices active in the climate change debate, rather than solely theorising about their rationales and opinions. It is also methodologically novel in its use of a visual spectrum onto which interviewees placed their own opinion and their perspective of the opinions of others. Several overlapping rationales are identified across climate scientists' and sceptical voices' opinions and experiences, including a sense of duty to publicly engage, agreement that complete certainty about the complex assemblage of climate change is unattainable, and that political factors are a central focus in the climate change debate. It provides a critical analysis of the motivations behind the different actors' experiences and suggests areas where self-reflexivity, as well as identifying common motivations, may engender dialogue across areas of both scientific and political debate. Through the use of narrative interview methods and the subsequent identification of commonalities, it also directly contributes towards understandings of strategies to diffuse antagonism and polarisation within controversial situations.

Chapter 5: *The impact of controversy on the production of scientific knowledge*, is the first of the two papers investigating the impact of knowledge contestation. While controversy is recognised as influencing the science-policy interface, a significant gap in the literature exists regarding how controversy may fundamentally shape the production of scientific knowledge itself. In other words, while there have been several attempts to describe the disagreements that comprise the climate change debate, scant attention has been given to the fundamental question of whether this knowledge controversy actually matters. Accordingly, this paper focuses on both the impact of controversy on scientific practice and on scientific agency, defined respectively as

agency in the choice and employment of the 'material practices that embody the *work of doing science*' (Roosth and Silbey, 2009: 459, emphasis in the original). Based on interviews with 63 climate scientists, sceptical voices and others, it finds that whereas the majority of climate scientists do not consider sceptical voices to have an impact on scientific practice, the vast majority do identify impacts on scientific agency. The most commonly identified agency-related impact is increased caution, followed by disruption, a greater focus on communication, defensiveness and reluctance to publicly engage. Using Gieryn's (1983; 1999) concept of boundary work, the paper argues that the ability of scientists to distinguish between impacts on agency and practice is a performative process to maintain the epistemic authority of science (specifically, the outputs of scientific practice) as a distinct form of knowledge production. It also suggests that this delineation can be seen as a function of controversy, with the greater the impact of controversy, the less fluid and contingent the boundary between the two. This paper is theoretically novel as it provides a conceptual extension to Gieryn's theory, namely that boundary work may be understood as a more active and explicit process under conditions of public scientific controversy as scientists work to ensure the independence and unassailability of their cognitive authority in contested domains. In addition to uncovering the specific impacts experienced by climate scientists, it provides an important contribution to knowledge by providing a conceptual framework identifying the ways in which controversy may influence the scientific knowledge production process, focusing on the responses of individual scientists.

Chapter 6: *Post-decisional logics of inaction: The impact of climate controversy on policy decision-making*, aims to understand how knowledge controversy impacts policy decision-making. Combining the frameworks of knowledge controversy and Puchala's (1975) post-decisional politics, it identifies an important gap in the literature in terms of understanding how controversy may influence policy implementation. Thus, related to the work carried out in Chapter 5, it asks does knowledge controversy actually matter to policy decision-making? Emphasis has traditionally been placed on understanding the impact of controversy at the moment of policy development, but this research identifies place-based post-decisional logics of inaction that impact the post-implementation effectiveness of climate change policy in two case study locations, New Zealand (NZ) and the United Kingdom (UK). Based on thematic coding of interviews with 99 politicians, policy officials, climate scientists, sceptical voices and others, it finds distinct and highly-context specific post-decisional logics of inaction occurring in each location. In NZ, the protection of the country's current national economic interest

is the overwhelmingly dominant post-decisional logic of inaction, whereas in the UK scientifically-based arguments are found to be an influential feature of the policy environment. Potential explanations for the continued cognitive authority of scientifically-based contestation in the UK include the comparatively higher value of science as an input to policymaking as well as the ability for scientifically-based arguments to be politically resonant due to political economy considerations. This paper makes three key contributions. First, and fundamentally, it identifies how knowledge controversy may impact public decision-making processes. Second, whereas much of the literature on contentious politics generalises from studies carried out in the United States of America (USA) this research emphasises the importance of being attentive to both the temporal and spatial nuances of how policy can be subtly undermined in the post-implementation phase in different geographic contexts. Third, the introduction of the concept of post-decisional logics of inaction unpacks the dynamics of policy implementation and highlights the strongly post-decisional nature of climate change policy in particular.

Finally, the conclusion provided in Chapter 7 presents the main findings of this thesis as a whole. It summarises and critically discusses each of the five papers presented in Chapters 2-6 and then presents the key cross-cutting conclusions arising from this research. It also identifies limitations and associated avenues for further research.

1.2.1   Research location

A key starting premise for this research was that controversy about climate change may be understood as a largely Anglo-Saxon phenomenon (Painter, 2011). This is not to say that debates about climate change science and policy do not exist in other contexts; indeed, recent research has demonstrated its existence more widely (Austgulen and Sto, 2013; Soentgen and Bilandzic, 2014; Kaiser and Rhomberg, 2015; Liu, 2015). However, the visible antagonism that has been well-documented in Anglo-Saxon countries (Antilla, 2005; McCright and Dunlap, 2010; McCright and Dunlap, 2011a; McCright and Dunlap, 2011b; Young and Coutinho, 2013) provides a strong rationale for basing this research within a similar domain. Accordingly, the entirety of the research for this thesis was carried out using English-language academic literature, online information (such as blog posts) and other texts, and the interviews used in the research presented in Chapters 4-6 occurred in NZ and the UK.

Two case study locations were chosen to aid in the triangulation of the perspectives gathered (Stake, 2005) but also, in Chapters 5 and 6, to provide opportunities for comparative analysis. Ragin (1987) suggests that the aim of most comparative studies is to provide historically interpretive and/or causally analytic accounts. Chapters 5 and 6 respond to both aims, using the framework of a comparative case study both because of the 'intrinsic value' (1987: 35) accorded by a historically-attentive investigation that is sensitive to context, but also because of the ability it provides to suggest why particular conditions arise in particular geographic contexts.

NZ and the UK were chosen for four main reasons, the first three of which arise from key similarities found in both contexts. First, both locations are considered to have active debate about climate change (Painter, 2011; Sibley and Kurz, 2013; Tranter and Booth, 2015), yet are (respectively) under-examined compared to other comparable locations such as the USA or Australia (McCright and Dunlap, 2010; Oreskes and Conway, 2010; Buettner, 2012; Dunlap and McCright, 2015). Second, both have recently been home to important events in the climate change debate. In the UK in 2009, more than 1,000 emails and documents were released without authorisation from the University of East Anglia immediately prior to the 2009 United Nations Framework Convention on Climate Change (UNFCCC) conference in an event known colloquially as "Climategate". This event has been well examined in the literature (Nerlich, 2010; Ryghaug and Skjolsvold, 2010; Ravetz, 2011; Koteyko et al., 2012; Grundmann, 2012; Skrydstrup, 2013; Leiserowitz et al., 2013) and so while it is not the central focus of this research, serves as an important contributory factor to the analysis undertaken. In NZ in 2010, a group called the NZ Climate Science Coalition (NZCSC) formed the NZ Climate Science Education Trust (NZCSET) and took a case in the NZ High Court seeking to invalidate the official NZ temperature record. The judgement and costs were made against the NZCSET. Very limited analyses of this event have occurred to date in the literature (Hardcastle, 2014) and so the research contained within this thesis is an important contribution towards understanding its implications. Third, both countries have implemented major climate change policies which have been subject to public criticism (Bullock, 2012; Lockwood, 2013; Mason, 2013). In the UK the 2008 Climate Change Act mandates an 80% reduction in greenhouse gas (GHG) emissions compared to 1990 levels by 2050 and in NZ, the 2008 Climate Change Response (Emissions Trading) Amendment Act established an all-sectors, all-gases emissions trading scheme. Finally, as this research is partly concerned with the implementation of policy, pre-existing networks within the policy environments of both countries were

able to be exploited in order to gain a deeper and more comprehensive understanding of actual decision-making processes undertaken (Duke, 2002).

1.3 Notes on thesis format

This thesis follows the route of providing a set of publishable-quality papers on a set of related topics, framed by an original introduction, critical discussion and conclusion. For theses where co-authored work is included, the requirements of the Department of Geography and Environment at the London School of Economics and Political Science state that a minimum of two single-authored papers, plus at least two jointly-authored papers (to which the candidate has made a major contribution), are required. Chapters 2 and 5 are single-authored papers. Chapters 3 and 4 are co-authored with Dr Candice Howarth with each author contributing 50% of the work of each paper. Chapter 6 is co-authored with Dr Richard Perkins, with Dr Perkins contributing 50% of the work of the paper. Chapters 2 and 3 have been published and are also referred to within this thesis as Sharman (2014), and Howarth and Sharman (2015). Chapter 4 has been published as a working paper and is also referred to within this thesis as Sharman and Howarth (2015).

Where relevant, the text, figures and tables in each published paper remain as published, notwithstanding small editorial changes such as updates to spelling, figure numbering or citation formats to provide a coherent format throughout this thesis as a single document. References are presented at the end of each chapter.

1.4 Conclusion

The overarching goal of this thesis is to investigate climate change as a knowledge controversy. In order to achieve this goal, the form, value and impact of contested knowledge in the climate change debate are addressed, with five separate research papers exploring different yet interrelated elements within this overarching area of focus. It provides an original contribution to knowledge by identifying previously unknown sites of knowledge contestation within the climate change debate, in addition to contributory factors, and potential solutions to, debate polarisation. It also addresses a fundamental gap in the literature regarding the impact of controversy on the production of scientific knowledge and policy decision-making. The following five

chapters present each individual research paper, followed by a critical discussion of and conclusion to this thesis as a whole in Chapter 7.

1.5 Notes

1. Mainstream climate science is defined the scientific position on climate change as expressed in the fourth and fifth assessment reports of the Intergovernmental Panel on Climate Change (IPCC) (IPCC 2007; IPCC 2013).

2. In recognition of its vital role as a conduit between publics, scientists and policymakers, a vast and expanding literature investigates the role of the media in contributing to public opinion about climate change (Moser, 2010; Elsasser and Dunlap, 2013; Anderegg and Goldsmith, 2014; Boykoff, 2014; Dahl, 2014; Poberezhskaya, 2014; Schmidt et al., 2013; Zhao et al., 2014). This thesis recognises the important contribution of communications-based studies to examine climate change controversy, and aims to build on their findings by examining how other complementary factors such as language or direct interactions within the political process may influence climate change science and policy processes.

3. "Sceptical voice" is used in an attempt to move away from the problematic labelling constructs evident in the climate debate. The emphasis on the idea of a "voice" re-focuses on the human (the "who" someone is, rather than the "what") whilst also recognising the need for a pragmatic descriptor.

1.6 References

Akerlof K, Rowan KE, Fitzgerald D, et al. (2012) Communication of climate projections in US media amid politicization of model science. *Nature Climate Change* 2: 648-654.

Anderegg WRL and Goldsmith GR. (2014) Public interest in climate change over the past decade and the effects of the 'climategate' media event. *Environmental Research Letters* 9: 054005.

Anderegg WRL, Prall JW, Harold J, et al. (2010) Expert credibility in climate change. *Proceedings of the National Academy of Sciences of the United States of America* 107: 12107-12109.

Antilla L. (2005) Climate of scepticism: US newspaper coverage of the science of climate change. *Global Environmental Change* 15: 338-352.

Austgulen MH and Sto E. (2013) Norwegian scepticism and uncertainty about climate change. *Tidsskrift for Samfunnsforskning* 54: 123-152.

Beck S, Borie M, Esguerra A, et al. (2014) Climate change and the assessment of expert knowledge: Does the IPCC model need updating? *Bridges* 40.

Beck U. (1992) *Risk society: Towards a new modernity,* London: Sage.

Below A. (2008) US Presidential decisions on ozone depletion and climate change: A foreign policy analysis. *Foreign Policy Analysis* 4: 1-20.

Berkhout F. (2010) Reconstructing boundaries and reason in the climate debate. *Global Environmental Change* 20: 565-569.

Besel RD, Smith Besel R and Duffy BK. (2012) Michael Crichton, narrative critique, and the boundary work of scientific expertise. *StoryTelling: A Critical Journal of Popular Narrative* 12: 15-29.

Bolsen T, Druckman JN and Cook FL. (2015) Citizens', scientists', and policy advisors' beliefs about global warming. *The ANNALS of the American Academy of Political and Social Science* 658: 271-295.

Boykoff MT. (2013) Public enemy no. 1? Understanding media representations of outlier views on climate change. *American Behavioral Scientist* 57: 796-817.

Boykoff MT. (2014) Media discourse on the climate slowdown. *Nature Climate Change* 4: 156-158.

Boykoff MT and Olson SK. (2013) 'Wise contrarians': A keystone species in contemporary climate science, politics and policy. *Celebrity Studies* 4: 276-291.

Buettner A. (2012) Climate change in the media: Climate denial, Ian Plimer, and the staging of public debate. *New Zealand Journal of Media Studies* 12: 79-97.

Bullock D. (2012) Emissions trading in New Zealand: Development, challenges and design. *Environmental Politics* 21: 657-675.

Capstick S and Pidgeon N. (2013) What *is* climate change scepticism? Examination of the concept using a mixed methods study of the UK public. *Global Environmental Change* 24: 389-401.

Collins H. (2014) Rejecting knowledge claims inside and outside science. *Social Studies of Science* 44: 722-735.

Collins H and Evans R. (2002) The third wave of science studies. *Social Studies of Science* 32: 235-296.

Dahl T. (2014) Contested science in the media: Linguistic traces of news writers' framing activity. *Written Communication* 32: 39-65.

Demeritt D. (2000) The new social contract for science: Accountability, relevance, and value in US and UK science and research policy *Antipode* 32: 308-329.

Demeritt D. (2006) Science studies, climate change and the prospects for constructivist critique. *Economy and Society* 35: 453-479.

Douglas H. (2009) *Science, policy, and the value-free ideal,* Pittsburgh: University of Pittsburgh Press.

Douglas H. (2015) Politics and science: Untangling values, ideologies, and reasons. *The ANNALS of the American Academy of Political and Social Science* 658: 296-306.

Duke K. (2002) Getting beyond the 'official line': Reflections on dilemmas of access, knowledge and power in researching policy networks. *Journal of Social Policy* 31: 39-59.

Dunlap RE. (2013) Climate change skepticism and denial: An introduction. American Behavioral Scientist 57: 691-698.

Dunlap RE and McCright AM. (2015) Challenging climate change: The denial countermovement. In: Dunlap RE and Brulle RJ (eds) *Climate change and society: Sociological perspectives.* Oxford: Oxford University Press.

Elsasser SW and Dunlap RE. (2013) Leading voices in the denier choir: Conservative columnists' dismissal of global warming and denigration of climate science. *American Behavioral Scientist* 57: 754-776.

Evans R. (2015) What is expertise? Technical knowledge and political judgement. In: Berling TV and Bueger C (eds) *Security expertise: Practice, power, responsibility.* London: Routledge.

Forsyth T. (2003) *Critical political ecology,* Oxford: Routledge.

Fudge S and Peters M. (2011) Behaviour change in the UK climate debate: An assessment of responsibility, agency and political dimensions. *Sustainability* 3: 789-808.

Funtowicz SO and Ravetz JR. (1993) Science for the post-normal age. *Futures* 25: 739-755.

Gieryn TF. (1983) Boundary-work and the demarcation of science from non-science: Strains and interests in professional ideologies of scientists. *American Sociological Review* 48: 781-795.

Gieryn TF. (1999) *Cultural boundaries of science: Credibility on the line,* Chicago: University of Chicago Press.

Grundmann R. (2007) Climate change and knowledge politics. *Environmental Politics* 16: 414-432.

Grundmann R. (2009) The role of expertise in governance processes. *Forest Policy and Economics* 11: 398-403.

Grundmann R. (2012) The legacy of climategate: Revitalizing or undermining climate science and policy? *Wiley Interdisciplinary Reviews: Climate Change* 3: 281-288.

Grundmann R. (2013) Debunking sceptical propaganda. *BioSocieties* 8: 370-374.

Grundmann R and Stehr N. (2003) Social control and knowledge in democratic societies. *Science and Public Policy* 30: 183-188.

Hannigan J. (2006) *Environmental sociology,* Oxford: Routledge.

Hardcastle L. (2014) Can't see the science for the solicitors: Judicial review of scientific research in light of NIWA's case. *New Zealand Journal of Public and International Law* 12: 291-320.

Hess DJ. (2014) When green became blue: Epistemic rift and the corralling of climate science. *Political Power and Social Theory* 27: 123-153.

Hobson K and Niemeyer S. (2012) "What sceptics believe": The effects of information and deliberation on climate change scepticism. *Public Understanding of Science* 22: 396-412.

Hoffman A. (2011a) The culture and discourse of climate skepticism. *Strategic Organization* 9: 1-8.

Hoffman A. (2011b) Talking past each other? Cultural framing of skeptical and convinced logics in the climate change debate. *Organization & Environment* 24: 3-33.

Hoppe R. (2005) Rethinking the science-policy nexus: from knowledge utilization and science technology studies to types of boundary arrangements. *Poiesis & Praxis* 3: 199-215.

Howarth C and Sharman A. (2015) Labeling opinions in the climate debate: A critical review. *Wiley Interdisciplinary Reviews: Climate Change* 6: 239-254.

Hulme M. (2009) *Why we disagree about climate change: Understanding controversy, inaction and opportunity,* Cambridge: Cambridge University Press.

IPCC. (2007) Climate change 2007: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. In: Solomon S, Qin D, Manning M, et al. (eds) *IPCC Fourth Assessment Report.* Cambridge: Cambridge University Press.

IPCC. (2013) Climate change 2013: The physical science basis. Working Group I contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. In: Stocker TF, Qin D, Plattner G-K, et al. (eds) *IPCC Fifth Assessment Report.* Cambridge: Cambridge University Press.

Kaiser J and Rhomberg M. (2015) Questioning the doubt: Climate skepticism in German newspaper reporting on COP17. *Environmental Communication*, doi: 10.1080/17524032.2015.1050435.

Kane O. (2013) Science, expertise and environmental controversies. Some reflections about the Canadian case. *Canadian Journal of Media Studies* 11: 1-12.

Kelly G. (2010) Climate change policy: Actions and barriers in New Zealand. *International Journal of Climate Change Impacts and Responses* 2: 277-290.

Knight G and Greenberg J. (2011) Talk of the enemy: Adversarial framing and climate change discourse. *Social Movement Studies* 10: 323-340.

Koteyko N, Jaspal R and Nerlich B. (2012) Climate change and 'climategate' in online reader comments: A mixed methods study. *The Geographical Journal* 179: 74-86.

Lacey H. (2015) 'Holding' and 'endorsing' claims in the course of scientific activities. *Studies in History and Philosophy of Science Part A* 53: 89-95.

Latour B. (1987) *Science in action,* Cambridge MA: Harvard University Press.

Lave R. (2015) The future of environmental expertise. *Annals of the Association of American Geographers*.

Leiserowitz A. (2006) Climate change risk perception and policy preferences: The role of affect, imagery, and values. *Climatic Change* 77: 45-72.

Leiserowitz A, Maibach EW, Roser-Renouf C, et al. (2013) Climategate, public opinion, and the loss of trust. *American Behavioral Scientist* 57: 818-837.

Liu JC-E. (2015) Low carbon plot: Climate change skepticism with Chinese characteristics. *Environmental Sociology*, doi: 10.1080/23251042.2015.1049811.

Lockwood M. (2013) The political sustainability of climate policy: The case of the UK Climate Change Act. *Global Environmental Change* 23: 1339-1348.

Longino HE. (2013) The social dimensions of scientific knowledge. In: Zalta EN (ed) *The Stanford Encyclopedia of Philosophy (Spring 2013 Edition).* Stanford, CA: Stanford University.

Lorenzoni I, Jones M and Turnpenny JR. (2007) Climate change, human genetics, and post-normality in the UK. *Futures* 39: 65-82.

Martin B. (2014) Censorship and free speech in scientific controversies. *Science and Public Policy*, doi: 10.1093/scipol/scu061.

Martin B and Richards E. (1995) Scientific knowledge, controversy, and public decision-making In: Jasanoff S, Markle GE, Petersen JC, et al. (eds) *Handbook of science and technology studies.* Newbury Park, CA: Sage, 506-526.

Martin N and Rice J. (2014) Rebalancing climate change debate and policy: An analysis of online discussions. *Environmental Policy and Governance* 24: 338-350.

Mason E. (2013) The New Zealand Emissions Trading Scheme: What has gone wrong and what might we achieve? *New Zealand Journal of Forestry* 58: 30-34.

McCright AM and Dunlap RE. (2003) Defeating Kyoto: The conservative movement's impact on U.S. climate change policy. *Social Problems* 50: 348-373.

McCright AM and Dunlap RE. (2010) Anti-reflexivity: The American conservative movement's success in undermining climate science and policy. *Theory Culture & Society* 27: 100-133.

McCright AM and Dunlap RE. (2011a) Cool dudes: The denial of climate change among conservative white males in the United States. *Global Environmental Change* 21: 1163-1172.

McCright AM and Dunlap RE. (2011b) The politicization of climate change and polarization in the American public's views of global warming, 2001–2010. *Sociological Quarterly* 52: 155-194.

McGarity TO. (2003-2004) Our science is sound science and their science is junk science: Science-based strategies for avoiding accountability and responsibility for risk-producing products and activities. *University of Kansas Law Review* 52: 897-938.

Moser SC. (2010) Communicating climate change: history, challenges, process and future directions. *Wiley Interdisciplinary Reviews: Climate Change* 1: 31-53.

Naylor R, Maye D, Ilbery B, et al. (2014) Researching controversial and sensitive issues: Using visual vignettes to explore farmers' attitudes towards the control of bovine tuberculosis in England. *Area* 46: 285-293.

Nerlich B. (2010) 'Climategate': Paradoxical metaphors and political paralysis. *Environmental Values* 19: 419-442.

Nisbet MC and Markowitz EM. (2014) Expertise in an age of polarization: Evaluating scientists' political awareness and communication behaviors. *The ANNALS of the American Academy of Political and Social Science* 658: 136-154.

Nowotny H, Scott P and Gibbons M. (2001) *Re-thinking science: Knowledge and the public in an age of uncertainty,* Cambridge: Polity.

Oreskes N and Conway EM. (2010) *Merchants of doubt: How a handful of scientists obsured the truth on issues from tobacco smoke to global warming,* New York: Bloomsbury Press.

Painter J. (2011) *Poles apart: The international reporting of climate scepticism,* Oxford: University of Oxford.

Pfister T and Horvath A. (2014) Reassessing expert knowledge and the politics of expertise. *Innovation: The European Journal of Social Science Research* 27: 311-316.

Pinch TJ. (2001) Scientific controversies. In: Smelser NJ and Baltes PB (eds) *International encyclopedia of the social & behavioral sciences.* Oxford: Pergamon, 13719-13724.

Pinch TJ and Bijker WE. (1984) The social construction of facts and artefacts: Or how the sociology of science and the sociology of technology might benefit each other. *Social Studies of Science* 14: 399-441.

Poberezhskaya M. (2014) Media coverage of climate change in Russia: Governmental bias and climate silence. *Public Understanding of Science* 24: 96-111.

Puchala DJ. (1975) Domestic politics and regional harmonization in the European Communities. *World Politics* 27: 496-520.

Ragin C. (1987) *The comparative method: Moving beyond qualitative and quantitative strategies,* Berkeley, CA: University of California Press.

Rahmstorf S. (2005) The climate sceptics. In: Re M (ed) *Weather catastrophes and climate change: is there still hope for us?* Munich: Munich Re, 76-83.

Ravetz JR. (2011) 'Climategate' and the maturing of post-normal science. *Futures* 43: 149-157.

Rayner S. (2009) Foreward. In: Hulme M (ed) *Why we disagree about climate change: Understanding controversy, inaction and opportunity.* Cambridge: Cambridge University Press, xxi-xxiv.

Rayner S. (2012) Uncomfortable knowledge: The social construction of ignorance in science and environmental policy discourses. *Economy and Society* 41: 107-125.

Reddy BS and Assenza GB. (2009) The great climate debate. *Energy Policy* 37: 2997-3008.

Rehg W. (2011) Evaluating Complex Collaborative Expertise: The Case of Climate Change. *Argumentation* 25: 385-400.

Rip A. (1985) Experts in public arenas. In: Otway H and Peltu M (eds) *Regulating industrial risks : science, hazards and public protection.* London: Butterworths, 94-110.

Rittel HWJ and Webber MM. (1973) Dilemmas in a general theory of planning. *Policy Sciences* 4: 155-169.

Roosth S and Silbey S. (2009) Science and technology studies: From controversies to post-humanist social theory. In: Turner BS (ed) *The new Blackwell companion to social theory.* Chichester: Blackwell Publishing Ltd, 451-474.

Ryghaug M and Skjolsvold TM. (2010) The global warming of climate science: Climategate and the construction of scientific facts. *International Studies in the Philosophy of Science* 24: 287-307.

Sarewitz D. (2000) Science and environmental policy: An excess of objectivity. In: Frodeman R (ed) *Earth matters: The earth sciences, philosophy and the claims of community.* London: Prentice Hall, 79-98.

Sarewitz D. (2004) How science makes environmental controversies worse. *Environmental Science & Policy* 7: 385-403.

Schäfer MS. (2012) Online communication on climate change and climate politics: A literature review. *Wiley Interdisciplinary Reviews: Climate Change* 3: 527-543.

Schmidt A, Ivanova A and Schäfer MS. (2013) Media attention for climate change around the world: A comparative analysis of newspaper coverage in 27 countries. *Global Environmental Change* 23: 1233-1248.

Schmidt CW. (2010) A closer look at climate change skepticism. *Environmental Health Perspectives* 118: A536-A540.

Shapiro JM. (2011) On the Limits of Expert Credibility: Theory and an Application to Climate Change. Chicago Booth and NBER.

Sharman A. (2014) Mapping the climate sceptical blogosphere. *Global Environmental Change* 26: 159-170.

Sharman A and Howarth C. (2015) Climate stories: Why do climate scientists and sceptical voices participate in the climate debate? *Centre for Climate Change Economics and Policy Working Paper No. 216, Grantham Research Institute on Climate Change and the Environment Working Paper No.191.* London: LSE.

Sibley CG and Kurz T. (2013) A model of climate belief profiles: How much does it matter if people question human causation? *Analyses of Social Issues and Public Policy* 13: 245-261.

Skrydstrup M. (2013) Tricked or troubled natures? How to make sense of "climategate". *Environmental Science & Policy* 28: 92-99.

Soentgen J and Bilandzic H. (2014) Die Struktur klimaskeptischer Argumente. Verschwörungstheorie als Wissenschaftskritik (The structure of climate skeptical arguments. Conspiracy theory as a critique of science). *GAIA - Ecological Perspectives for Science and Society* 23: 40-47.

Solli J and Ryghaug M. (2014) Assembling climate knowledge: The role of local expertise. *Nordic Journal of Science and Technology Studies* 2: 18-28.

Spruijt P, Knol AB, Vasileiadou E, et al. (2014) Roles of scientists as policy advisers on complex issues: A literature review. *Environmental Science & Policy* 40: 16-25.

Stake RE. (2005) Qualitative case studies. In: Denzin NK and Lincoln YS (eds) *The Sage Handbook of Qualitative Research.* Third ed. Thousand Oaks, CA: Sage, 443-466.

Stehr N and Grundmann R. (2011) *Experts: The knowledge and power of expertise,* Oxford: Routledge.

Stoll-Kleemann S, O'Riordan T and Jaeger CC. (2001) The psychology of denial concerning climate mitigation measures: Evidence from Swiss focus groups. *Global Environmental Change* 11: 107-117.

Tangney P and Howes M. (2015) The politics of evidence-based policy: A comparative analysis of climate adaptation in Australia and the UK. *Environment and Planning C: Government and Policy*, doi: 0.1177/0263774X15602023.

Tranter B and Booth K. (2015) Scepticism in a changing climate: A cross-national study. *Global Environmental Change* 33: 154-164.

Turner S. (2001) What is the problem with experts? *Social Studies of Science* 31: 123-149.

Turner S. (2014) *The politics of expertise,* Oxford: Routledge.

Unsworth KL and Fielding KS. (2014) It's political: How the salience of one's political identity changes climate change beliefs and policy support. *Global Environmental Change* 27: 131-137.

Veselková M. (2014) Science, stories and the anti-vaccination movement. *Human Affairs* 24: 287-298.

Whatmore SJ. (2009) Mapping knowledge controversies: Science, democracy and the redistribution of expertise. *Progress in Human Geography* 33: 587-598.

Whitmarsh L. (2009) Behavioural responses to climate change: Asymmetry of intentions and impacts. *Journal of Environmental Psychology* 29: 13-23.

Young N and Coutinho A. (2013) Government, anti-reflexivity, and the construction of public ignorance about climate change: Australia and Canada compared. *Global Environmental Politics* 13: 89-108.

Zhao X, Rolfe-Redding J and Kotcher JE. (2014) Partisan differences in the relationship between newspaper coverage and concern over global warming. *Public Understanding of Science*, doi: 10.1177/0963662514558992.

Chapter 2. Mapping the climate sceptical blogosphere

Abstract

While mainstream scientific knowledge production has been extensively examined in the academic literature, comparatively little is known about alternative networks of scientific knowledge production. Online sources such as blogs are an especially under-investigated site of knowledge contestation. Using degree centrality and node betweenness tests from social network analysis, and thematic content analysis of individual posts, this research identifies and critically examines the climate sceptical blogosphere and investigates whether a focus on particular themes contributes to the positioning of the most central blogs. A network of 171 individual blogs is identified, with three blogs in particular found to be the most central: *Climate Audit*, *JoNova* and *Watts Up With That*. These blogs predominantly focus on the scientific element of the climate debate, providing either a direct scientifically-based challenge to mainstream climate science, or a critique of the conduct of the climate science system. This overt scientific framing, as opposed to explicitly highlighting differences in values, politics, or ideological worldview, appears to be an important contributory factor in the positioning of the most central blogs. It is suggested that these central blogs are key protagonists in a process of attempted expert knowledge de-legitimisation and contestation, acting not only as translators between scientific research and lay audiences, but, in their reinterpretation of existing climate science knowledge claims, are acting themselves as alternative public sites of expertise for a climate sceptical audience.

Keywords: climate scepticism, knowledge, network, blog, social network analysis

2.1 Introduction

Outside the paradigm of mainstream climate science, and particularly in online environments, the validity of an accepted body of research underlying the scientific case for anthropogenic climate change (defined here as agreement with Section 2 (Causes of change) of the IPCC Fourth Assessment Report: Climate Change 2007) is actively disputed (Jacques et al., 2008; Poortinga et al., 2011; Washington and Cook, 2011; Corner et al., 2012; Hobson and Niemeyer, 2012). Arguments that may be

considered as "climate sceptical" include, *inter alia*, that climate science is factually incorrect in terms of its scientific basis, a conspiracy among scientists to maintain or increase funding opportunities, or a politically-based rationale to increase regulation or taxes (Oreskes and Conway, 2010). This debate about climate science, as well as controversy regarding mitigation or adaptation policies, provides fertile ground for blogs. While most previous research has focused on the expression of climate scepticism in traditional media outlets (Antilla, 2005; Hoffman, 2011b; Painter and Ashe, 2012), this research contributes towards the small but growing body of literature addressing the role of virtual spaces in climate sceptical knowledge production (Gavin and Marshall, 2011; Koteyko et al., 2012; Cormick, 2011). It maps the climate sceptical blogosphere and uses social network analysis (SNA) to identify those blogs which are the most central within the overall blog network. It also uses thematic analysis to understand why those blogs identified as the most central occupy such positions of importance.

Over a decade ago, Rogers and Marres (2000) mapped the online climate change debate issue network, focusing on websites with URLs ending with .org or .gov. However, this analysis excluded the then nascent field of blogs (internet pages comprising a series of entries or chunks of information known as posts, most often arranged in reverse chronological order, either authored by a single author known as a "blogger" or by multiple contributors (Bar-Ilan, 2005)). In 2000 there were fewer than 30,000 blogs in the United States of America (USA), but by 2005 this had increased to over 5.3 million (Hsu and Lin, 2008) and by 2011, there were an estimated 181 million blogs globally (NM Incite, 2012) (please note that due to the lack of a single time-series record of global blog numbers, these statistics are not directly comparable). Technorati, a blog search engine and directory, estimates there to be approximately 16,300 science blogs worldwide (Technorati, 2013); however how these blogs are categorised as such is unknown. Furthermore, there appears to be no publicly available count of the total number of blogs addressing climate change (regardless of perspective). As a result, little is known about the climate sceptical blogosphere. The blogosphere—a 'densely interconnected conversation' (Herring et al., 2005: 1)—is the network of blogs and their linkages to one another, such as through hyperlinks, references to other blogs or bloggers within posts, or by commenting on others' blogs. Climate sceptics are perceived to be 'very present online and particularly in the blogosphere' (Schäfer, 2012: 529) yet this perception has yet to be adequately addressed with empirical research. Understanding blogs as sites of knowledge

formation and contestation is critical because, as Hsu and Lin (2008: 65) note, blogs can 'attract tremendous attention and exert great influence on society', resonating with different groups according to their content, format and authorship (Bar-Ilan, 2005). Furthermore, while blogs may have low overall visitor numbers as compared to traditional media outlets such as television news or radio broadcasts, their relatively high readership by so-called 'elite' actors such as journalists enables a much higher penetration of blog-generated or transmitted ideas to the general public than may otherwise be expected (Farrell and Drezner, 2008). For example, in a study of 300 journalists, Dautrich and Barnes (2005a; 2005b) find that 83% reported having used blogs (with 41% reporting using them at least once per week) as compared to only 7% of the general population.

Focusing on the blogosphere as a network also enables key sites of influence to be identified and to understand whether information or viewpoints are widely generated and dispersed, or shaped by a smaller number of attitudinal influencers. As blogs become an increasingly important contributor to public discourse (Carlson, 2007) and inspire reflection on the use of knowledge in decision-making (Ravetz, 2012), identifying the main sites of sceptical opinion formation and the arguments employed is also valuable to those engaged in science communication or climate policy decision-making. Finally, this paper aims to make a wider contribution to the literature on alternative knowledge networks by highlighting the potentially significant role of central blogs as knowledge gatekeepers, and also how attempts are made to disrupt traditional understandings of how knowledge is both formed and accepted as legitimate.

2.2   Knowledge, networks and contestation

Traditional frameworks of scientific knowledge production limited its creation to official spaces such as universities, and as the domain of those who were formally qualified as arbiters of knowledge by virtue of their academic credentials (Martin and Richards, 1995). These actors, closely networked within small epistemic communities of practice, were perceived as creating scientific knowledge that was 'objective and context-free' (Wynne, 1992: 282), with a clear distinction between the legitimacy of the knowledge created by the scientist and the 'man-in-the-street' [*sic*] (Merton, 1973 [1942]: 277). Insights from the sociology of scientific knowledge have challenged these frameworks, with theories such as Mode-2 knowledge production or post-normal

science explaining that knowledge is created across multiple sites and by multiple actors (Funtowicz and Ravetz, 1993; Gibbons et al., 1994; Nowotny et al., 2003). Crompton (2007) explains that these new knowledge networks involve the public speaking back to science, creating new public arenas ("agoras") where scientific information is contested to make it more socially robust. The climate sceptical blogosphere, as a site of active knowledge contestation, could therefore be understood as a (virtual) site of Mode-2 knowledge production. Indeed, Donald (2011) suggests that, by understanding climate science as post-normal, networks of contrarian bloggers may also be understood as new types of global advocacy networks. However, it is unclear whether the blogosphere is a "functioning" agora as Crompton suggests is the case in her description of the orphan drug network. The mutual learning necessary for a functioning agora where the 'public [is] accepted as a legitimate partner exerting democratic rights of participation' (Crompton, 2007: 201) appears to be less apparent overall in the case of climate change, with Hoffman (2011b: 9) identifying a 'logic schism' between different actors in the debate, across which dialogue is extremely difficult. Climate scepticism, as a challenge to mainstream climate science and policy, does not reflect 'an absence of certainty, but rather of *contradictory certainties*: several divergent and mutually irreconcilable sets of convictions both about the difficulties we face and the available solutions' (Hannigan, 2006: 29, emphasis in the original). As well as policy choices, scientific evidence itself is actively disputed, with, for example, knowledge claims presented within the climate debate as either "sound" or "junk" science (McCright and Dunlap, 2003). Sound science emerged as a term during the early 2000s bovine spongiform encephalopathy health scare in the USA when scientific—instead of economic—rationales were employed to defend policy responses. Evidence that does not fit the desired policy frame is conversely labelled as "junk science", although critics using the sound science argument often refer to incomplete data and scenario modelling (two things inherent to climate science) as key elements of junk science, rather than engaging in a direct debate about the quality of the extant data itself. As McGarity (2003-2004: 901) argues, 'stripped of their rhetorical flourish, "junk science" means "their science" and "sound science" means "our science"'.

In contrast to controversies such as the health impacts of tobacco smoking which is no longer widely publicly disputed, the more scientifically abstract nature of climate science and its inherently values-laden character means that scientific evidence alone is inadequate to drive policy decision-making (Hulme, 2009). Hoffman (2011a) argues that the climate debate may have entered into the realm of what Pielke Jr. (2007) coins

"abortion politics", that is, a situation where no amount of scientific information can reconcile the different values held on a certain topic. This is in contrast to the "rational-instrument" approach whereby science is seen as providing 'verifiable facts about reality on which rational policy decisions can be based' (Gulbrandsen, 2008: 100) and which would suggest that climate change could be resolved by systematically uncovering factual knowledge. It is important to recognise that the range of potential policy responses to climate change each hold deeply embedded ideological implications, with Hoffman (2011a: 3) providing the example of attendees at a climate sceptics' conference in 2010 stating that 'the issue isn't the issue'; instead, that 'climate change is just another attempt to diminish our freedom'.

While the academic literature to date has mainly focused on the manifestation of climate scepticism in the mainstream media (Boykoff, 2007; Schmidt et al., 2013), little work has been done to understand why climate sceptical blogs exist and what their role may be as public sites of knowledge contestation. Several elements are relevant to consider, including conflict over the legitimacy of the public's ability to contribute valid climate change knowledge, particularly where it disputes mainstream climate science (Douglas, 2009), mistrust by some regarding the data and methods used to create climate predictions (exemplified by the "Climategate" controversy, where more than 1000 emails and documents were stolen or leaked from the University of East Anglia in 2009), or a desire for greater transparency overall in the scientific process (Nerlich, 2010). The notion of knowledge networks under Mode-2 conditions provides a particularly useful analytical framework, as the production of knowledge and specifically, its *re*production by different actors in a network helps to identify which types of information are most relevant to a particular debate, as well as showing how framing and sources contribute to knowledge legitimacy. For example, Kahan et al. (2011) suggest that even the perception of whether a scientific consensus *exists* on a certain topic is determined by both the source of the information in question, and the side upon which consensus forms. This flow of knowledge enables the creation of what Cope and Kalantzis (2009: 5) term 'dispersed communities of expertise', with the format of online networks in particular promoting near instant feedback on knowledge claims (Koteyko et al., 2012).

Furthermore, while the ways in which mainstream science and policy is organised and interact have been the subject of considerable attention (Zuckerman and Merton, 1971; McCright and Dunlap, 2003; Berryman, 2006; Daviter, 2007), correspondingly little is

known about contemporary online sites of knowledge contestation and how this knowledge is created and disseminated across virtual space. These new sites of knowledge (re)production that blogs embody are important to address because they facilitate 'a shift in the balance of textual agency between the author and reader' (Cope and Kalantzis, 2009: 6) by enabling contested knowledge to be freely circulated, and to act as direct challengers to "official" expertise. While it is possible that these climate sceptical blogs are not making a significant impact on public discourse outside the online environment, this seems unlikely, as blogs are increasingly recognised as important contributors to the public climate change debate (Guimaraes, 2012). Blogs' low entry barriers compared to peer-reviewed journals, which are generally too expensive to access for non-institutional readers (Harnad, 1998) or written in an overly obtuse or technical style (Culler and Lamb, 2003; Eagle et al., 2012), may also give them a unique position as a mediator of public discourse.

2.3   A networked blogosphere

As a tool to express opinions and disseminate ideas, blogs are an increasingly popular online phenomenon (Wei Lai, 2009), particularly given the rise of free blogging platforms which require little technological know-how (Hookway, 2008). Blogospheres, as networked user communities, contribute to the creation of attitudes and transfer of information and ideas (Tremayne et al., 2006; Tremayne, 2007; Bruns et al., 2011; Etling et al., 2010; Moe, 2011). However, while individual blogs have been recognised as significant disseminators of knowledge, particularly knowledge which may be deemed partisan (Lowrey, 2006), comparatively little work has been undertaken that examines these sites of knowledge contestation as a networked whole.

Social network analysis (SNA) is a useful method to examine blogospheres as it provides a coherent mechanism to interrogate their structure. For example, the use of links between blogs enables the connectedness of the blogosphere to be explicitly mapped (see Herring et al., 2005: for a more detailed discussion of the merits of SNA in analysing blogospheres). A social network may be thought of as a 'collection of social actors and their interconnections... [which] consists of nodes (social actors) and links between the nodes (the interconnections)' (Sun and Qiu, 2008: 1769). SNA is used to analyse these links, emphasising the interconnections between actors rather than the characteristics of the actors themselves (Borgatti et al., 2009). Centrality is a core concept within SNA, with a variety of approaches (such as degree, closeness or

betweenness) used to measure 'the locations of individuals in terms of how close they are to the "center" of the action in a network' (Hanneman and Riddle, 2005: 147). Those nodes in particularly central positions are also understood in SNA as potentially powerful, with power in this context existing as a result of the advantageous position of a node in comparison to others. While the 'question of how structural position [i.e. centrality] confers power remains a topic of active research and considerable debate' (Hanneman and Riddle, 2005: 168), this research will follow the lead of Brass (1984: 520) who argues that, 'actors or units occupying central positions in a network are viewed as potentially powerful because of their greater access to and possible control over relevant resources'. This focus on centrality is particularly relevant to the study of a blogosphere, as it enables a focus on those blogs most likely to play a role as pivotal sites of opinion formation and reinforcement.

In addition to centrality, clustering is also argued to be an important characteristic of a blogosphere (Watts, 1999; Barabási et al., 2000; Newman et al., 2002) whereby relationships are indicated by bloggers linking to or commenting on others' blogs, or via the existence of "blog-rolls" which are links to other blogs displayed on either the home-page or links page of a blog (Adamic and Glance, 2005). Bruns et al. explain the importance of blog-roll links:

> Patterns of interlinkage between contemporaneous blog-rolls indicate the existence of a long-term network of recognition between peers. Sites with many incoming and outgoing links may be understood as hubs for communication in this network; sites with many incoming, but limited outgoing links may be understood as central sources for information; sites with many outgoing but few incoming links may be understood as (not necessarily central) distributors of attention to other members of the network (2008: 3, emphasis in the original).

Blog-rolls indicate long-term connectivity between bloggers, as opposed to a link found within a single post, and can also be understood as an indicator of ideological closeness or shared interest (Caiani and Wagemann, 2009). The number of incoming versus outgoing linkages is interesting, as those blogs with 'a high number of incoming links…can be understood as the most respected blogs in the overall population' (Bruns et al., 2008: 6), whereas those blogs with many incoming *and* outgoing links are important hubs within the network, playing a role as connector nodes, and thus contributing to a tight-knit cluster formation (Sun and Qiu, 2008). Rogers (2012) argues that these incoming links may serve as an indicator of reputation and, what he

terms as the "politics of association". That is, blogs will only link to others with whom they want to be associated in an effort to create a coherent group (Niederer, 2013).

Also of relevance is the user community's perception of the credibility of the information contained and shared within the blogosphere. This is particularly important to climate sceptical blogs providing an alternative explanation to mainstream climate science (as opposed to blogs focusing on, for example, climate change policy choices). In a survey of over 3,700 readers of more than 60 blogs of diverse content, Johnson and Kaye (2004) found that nearly three-quarters considered blogs "moderately" to "very" credible sources of information, with their particular strength being the provision of in-depth information. Readers did however acknowledge that the accuracy and neutrality of blogs may be questionable, with half the respondents judging blogs as either "somewhat" or "not very" accurate or fair (this is a significantly lower assessment of credibility than that perceived of Wikipedia entries, as found by Chesney, 2006). Yet Johnson and Kaye argue that this does not appear to be inherently problematic as blog readers tend to seek out information to support their own views (Kahan et al., 2011), and as Hsu and Lin (2008) propose, bloggers themselves are blogging because they want to share their own opinions and influence others by the knowledge they provide.

2.4   Method

A multi-stage process was followed in order to a) map the climate sceptical blogosphere, b) identify the most central blogs, and c) understand why the most central blogs occupy such positions of importance. This section explains the blogosphere mapping process, with Section 2.5 discussing the SNA tests and Section 2.6 outlining the thematic content analysis.

To identify the population of climate sceptical blogs, the search string "climate blog" was entered into *WebCrawler*, with the initial 12 pages of results used as the basis from which all further blogs were identified via a snowball method using blog-roll links. *WebCrawler* is an integrated online metasearch engine combining Google Search and Yahoo! Search results. At the time of research, it also included Microsoft's Bing Search. A metasearch engine was chosen in order to obtain the most comprehensive search results possible, as it combines the results from multiple search engines into a single output (Lawrence and Giles, 1999). Inclusion and exclusion criteria were

implemented in order to create a coherent dataset, with all blogs identified and assessed manually to ensure only relevant blogs were identified (Heath et al., 2009). First, the blog had to identify itself as a blog about climate change, either through use of the term "climate" or "global warming" in the title, or through substantive discussion in posts. Substantive was determined as at least 50% or more of the blog's content and was assessed in two ways. If tags were allocated to a post, a frequency analysis was undertaken and if 50% or more of the posts were tagged as "climate change" or similar, it was added to the network. Where tags were not present or were ambiguous, the first five pages of each blog were analysed using content analysis to determine whether 50% or more of the posts could be categorised as climate change-related. While this coding process is inherently subjective, it did not limit the rigour of the analysis as this process of 'recognizing (seeing) an important moment and encoding it (seeing it as something) prior to a process of interpretation' (Fereday and Muir-Cochrane, 2006: 83) was based on an extensive grounding in the climate change literature. 37 blogs were excluded for not having climate change as majority content, including political blogs such as the *Australian TEA Party* or weather blogs such as the UK's *Met Office News Blog*.

Second, the blog had to be identified as climate *sceptical*. This was determined by individual assessment of each blog's content insofar as it employed language which agreed with Rahmstorf's (2005) typology of trend, attribution or impact climate scepticism. As Painter (2011: 54) explains, trend sceptics are 'those who say global temperatures are not warming', while attribution sceptics are 'those who say they [global temperatures] are warming, but argue that the anthropogenic contribution to global warming or climate change is over-stated, negligible, or non-existent compared to other factors like natural variations or sun spots' and impact sceptics are 'those who accept it is happening but for different reasons question its impacts or the need to do something about it'. While this was clearly evident in most cases, a categorisation system became a necessary addition in order to distinguish between types of blogs, as there was a marked difference in language employed. Two categories were developed: openly sceptical (category 1) and self-proclaimed "open-minded" (category 2). For example, compare the following excerpts in Table 2.1 from *Climate etc.*, a category 2 blog authored by Judith Curry (Georgia Institute of Technology) and *GORE LIED*, a category 1 blog authored under the pseudonym "The Editor", based in Oregon, USA. In the *GORE LIED* excerpts, the phrase 'the foundation for anthropogenic global warming is fraudulent' and the suggestion of climate scientists and policy-makers personally

profiting from the existence of climate change clearly identifies it as a category 1 blog. Conversely, in the *Climate etc.* excerpt, the discussion of the need for greater causal investigation into the scientific factors behind the physical manifestation of climate change is markedly different in tone, hence its classification as a category 2 blog.

Table 2.1: Category 1 and 2 language

Blog	About	Post excerpt
Climate etc.	'Climate Etc. provides a forum for climate researchers, academics and technical experts from other fields, citizen scientists, and the interested public to engage in a discussion on topics related to climate science and the science-policy interface.'	'In the case of main stream climate science, the physical mechanism for climate change is clearly posited as arising from external forcing: solar, volcanoes, anthropogenic greenhouse gases and aerosols. However, climate scientists have not racked their brains anywhere near hard enough to come up with other causal explanations. The main outstanding causal explanation that has been neglected is internal natural variability of the coupled ocean/atmosphere system.' (*Pseudoscience?*, 20 March 2012)
GORE LIED	'The main point here at GORE LIED is that Al Gore lied about anthropogenic global warming. It's pretty simple. I repeat that often, and prove it over and over. While that is my main quest, I also hope to entertain you along the way…The Climategate scandal has proved that the data that comprised the foundation for anthropogenic global warming is fraudulent, and as a result has tainted virtually every other study, conclusion, and public policy "solution" that had been produced or proposed. Therefore, GORE LIED firmly believes that Al Gore, and any other scientists or governmental officials that continue to fan the flames of man-made global warming alarmism to stoke public support for "solutions" that prove to enrich them in money or power be held legally liable for foisting a fraud on the public.'	'Joe Romm asks his readers, "What are you doing to prepare for climate impacts?" The beneficial-molecule-fearing Rommulans obediently reply in droves. One particular comment from a warmist blogger goes a bit beyond the question Romm posed, and predicts a very dark solution for an imagined future climate hell: *I'll also predict that laws permitting euthanasia will become commonplace in about two decades. The world will have to choose between keeping the old and ill fed and alive, and keeping the young and fit fed and alive. (Hopefully I'm exaggerating slightly in the second sentence, but maybe not.)* So, he might be exaggerating a bit about the choice of exactly who to euthanize, but he's *not* exaggerating about the actual euthanasia itself. Some of these people have lost their minds.' (*Climate death panels? Warmist blogger predicts 'laws permitting euthanasia will become commonplace in about two decades'*, 28 February 2012)

Third, the blog had to present new content, thus excluding three blogs that collated posts originally published elsewhere such as *Climate Depot*. Fourth, it had to present itself in a blog format, requiring elements typical to a blog such as post headings, dates, tags, and contributing author identification (Bar-Ilan, 2005). This excluded 57 websites. Fifth and finally, four blogs were excluded because they were not written predominantly in English. This is a recognised limitation of this research, as the presence of non-English language blogs in the identified network, and an unknown number of non-English language blogs that were not identified via blog-roll links, constitute a missing space of unknown size. However, this research is predominantly interested in English language blogs, building on previous research in the communication of climate scepticism which emphasises the Anglo-American or Anglo-Saxon nature of the phenomenon (Painter, 2011; Niederer, 2013). Six blogs were retired or appeared inactive, yet were included in the network as potential sources of static information. A blog containing pornographic images as well as climate sceptical posts was excluded, despite being linked to by several other blogs. Three parody blogs which purported to be climate sceptical, but on closer investigation were actually satirical in nature, were also excluded from the dataset such as *The Climate Scum*.

To carry out the SNA, a one-mode network adjacency matrix was created based on blog-roll linkages and analysed using the computer programme UCINET and its accompanying graphical visualisation software, NetDraw. As Borgatti et al. (1999: 15, emphasis in the original) explain, 'the rows and columns of the adjacency matrix [in UCINET] correspond to the nodes of the graph [in NetDraw], and the cells in the matrix correspond to pairs of nodes or *dyads*. A matrix value $X(i,j) = 1$ indicates the presence of a link between node *i* and node *j*, and $X(i,j) = 0$ indicates the absence of a link'. In this case, the matrix value of 1 indicated the existence of a blog-roll link. The inclusion and exclusion criteria were particularly important to the adjacency matrix, as to list all the blogs included on the identified blog-rolls without focusing on a particular topic would have resulted in a likely ever-expanding network of blogs. Some of the blog rolls differentiated their blog-roll links into groupings (such as "climate" or "politics") as well as identifying fellow sceptical blogs and those on the "other side" of the debate. *The Global Warming Heretic* provides a good example of this, with its blog roll divided into the following sections:

- Data (5 links)
- Fellow heretics (87 links)

- Mostly impartial (1 link)

- GW/CC [global warming/climate change] news (16 links)

- True believers, Hangers-on, Folks who don't know any better, and folks who should know better (54 links)

- Carbon brokers (4 links)

- Heretic sympathizers (1 link)

- Other heretics (non-AGW [anthropogenic global warming]) (5 links)

The Global Warming Heretic also provides a note about its classification system, with the categories explained as follows:

> *I have done my best to classify the links into the stated categories based on my impression about the general thrust of each of these sites. Sites classified as 'Fellow Heretics' will not necessarily agree with me on all issues related to climate change—they merely contain content that unapologetically diverges from the consensus. Sites classified as 'True Believers' are those that have accepted the essence of the AGW hypothesis—but some present their views reasonably rather than in the hysterical fashion of the CoGW [Church of Global Warming].*

In such cases, only those blogs identified as sceptical by the blogger themselves were added to the adjacency matrix. Both the adjacency and attribute matrices were analysed using UCINET and NetDraw, with the results explained in the following section.

2.5 Results

In total, 171 blogs were identified, 155 of which are allocated to category 1 (openly sceptical) with the remaining 15 identified as category 2 (self-proclaimed "open-minded"). Note however that this is a snapshot of the blogosphere created during March-April 2012. It is expected that many blogs will no longer exist by the date of publication and concomitantly, that many others will have been created. Of those blogs whose authorship could be determined (155 blogs, with authorship identified via the blogger naming their location), nearly half (75) are authored from within the USA. Where both author location and nationality were identified but were different, author location was chosen. In descending order of prevalence, the authorship of the remaining blogs is: Australia (32), United Kingdom (26), Canada (9), New Zealand (5),

and the Czech Republic, Denmark, Germany, India, Ireland, Israel, Italy and Sweden (1 each). It is interesting that seven of the blogs whose authorship could be determined come from predominantly non-English speaking countries, yet are written in English. This may be due to these bloggers' desire to connect with the predominantly Anglo-American/Saxon manifestation of climate scepticism as referred to above (Painter, 2011; Niederer, 2013).

Of the 171 blogs, 114 list links in a blog-roll. Only one blog (found via the initial scoping process using *WebCrawler*) is not linked to the remainder of the network. The geodesic distance of the entire network is measured at 2.71, that is, only 2.71 blogs on average separate each blog from another. While this may seem like a densely connected network, employing UCINET's density algorithm shows a density rating of only 0.06. The density of the network examines the proportion of possible ties that are present, with a density rating of 1 meaning that every blog would be directly connected. Thus, of all possible ties, only 6% are present, suggesting a low-density network. Figure 2.1, which visualises the blogosphere using an ego network display, clearly indicates that other clusters of relationships, for example through particularly central nodes, may instead be important to investigate. Using the arc method, the reciprocity of the network (how many blogs link to each other) was analysed to assess the blogosphere's interdependency, with a result of 19.93%. This result, where less than a quarter of blogs provide reciprocal links on their respective blog rolls, in addition to the low network density, appears to provide further evidence for a blogosphere that depends on central nodes. Three centrality tests were selected to achieve the goal of determining the most central nodes within the blogosphere. Those blogs that appeared in the top 10 of each reciprocal centrality test (for example, both in- and out-degree ratings) were placed on a short-list of central blogs for subsequent analysis. Table 2.2 outlines these tests and the short-listed blogs.
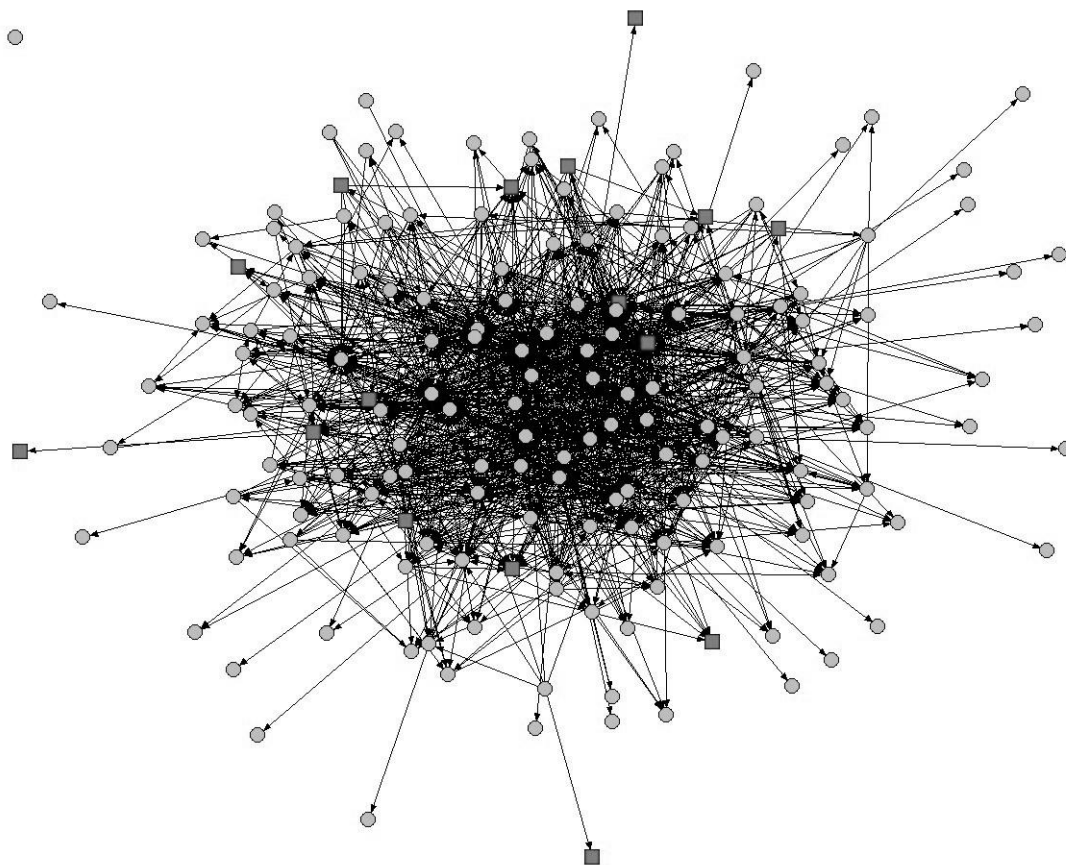
Figure 2.1: The climate sceptical blogosphere, where round nodes are category 1 (openly sceptical) and square nodes are category 2 (self-proclaimed "open-minded")

Table 2.2: Centrality tests

Test	Description	Detail	Most central blogs according to test results
Degree centrality (Freeman's approach)	Measurement of incoming and outgoing linkage (also known as in- and out-degree rating).	In-degree rating determines the most linked-to blog. Out-degree rating determines which blogs' blog-rolls are the most extensive.	• Bishop Hill • WUWT
Degree centrality (Bonacich's approach)	Measurement of centrality and power according to number of connections within the network.	A positive co-efficient of 0.5 determines centrality. Centrality is achieved if the blogs that are linked to on a blog-roll have themselves many subsequent links. A negative co-efficient of -0.5 determines power. Power is achieved if a blog is connected to many blogs without further links themselves.	• GORE LIED • The Friends of Carbon Dioxide • The Global Warming Heretic
Betweenness centrality	Measurement of centrality that shows those nodes upon which others depend to make connections.	A blog is central if it is situated on the shortest path between other pairs of actors in the network.	• Climate Audit • JoNova • ICECAP • No Frakking Consensus

Two tests for degree centrality (Freeman's and Bonacich's approach) were chosen as 'very simple, but...very effective measure[s] of...centrality' (Hanneman and Riddle, 2005: 148). Freeman's approach shows the centrality of a node based on its degree, that is, the number of connections a node has. In this case, the rating score represents the number of other blogs linking to that blog on their respective blog rolls. The blog with the highest in-degree rating according to Freeman's approach is *Watts Up With That (WUWT)*, with 54% of the blogosphere linking to *WUWT*, which claims to be the 'world's most viewed site on global warming and climate change'. Freeman's approach may also be used to analyse out-degree linkages, that is, examining which blogs' blog-rolls are the most extensive. While out-degree score is usually seen as a measure of how influential an actor is in a network, in this case, a blog has no control over whether it is included in another blogs' blog-roll. It is thus possible that out-degree score in a blogosphere context may instead be regarded as an indicator of desire to enhance the network, for example, by ensuring readers are aware that there exist other blogs that support the position of the original blog. Interestingly, only two blogs show both high

in- and out-degree linkages (*WUWT* and *Bishop Hill*). Tables 2.3 and 2.4 show the top 10 Freeman's approach scores for in- and out-degree linkage.

Table 2.3: Degree centrality (Freeman's approach) in-degree results

Rank	Blog	Score	Category	Blog-roll
1	Watts Up With That	93	1	Yes
2	Climate Audit	76	2	Yes
3	JoNova	55	1	Yes
4=	Bishop Hill	46	1	Yes
4=	ICECAP	46	1	Yes
6	Tom Nelson	42	1	Yes
7	No Frakking Consensus	37	1	Yes
8=	JunkScience	34	1	No
8=	Science and Public Policy Institute	34	1	Yes
10=	Climate etc.	32	2	Yes
10=	Climate Realists	32	1	No
10=	Roy Spencer	32	1	No
10=	the reference frame	32	1	No

Table 2.4: Degree centrality (Freeman's approach) out-degree results

Rank	Blog	Score	Category	Blog-roll
1	C3 Headlines	67	1	Yes
2	GORE LIED	57	1	Yes
3	Global Warming Science	51	1	Yes
4	Climate Change Dispatch	43	1	Yes
4=	Global Warming: A Worn-Out Hoax	43	1	Yes
6	Web Commentary	42	1	Yes
6=	Bishop Hill	42	1	Yes
8	Climate Research News	38	1	Yes
9=	ecomyths	36	2	Yes
9=	Watts Up With That	36	1	Yes
9=	Rajan's Take: Climate Change	36	1	Yes

Bonacich's approach for degree centrality is a more nuanced mechanism to determine both centrality and power based on the number of secondary connections attributed to a node. A positive coefficient of 0.5 is used to determine centrality, that is, whether the blogs that are linked to on a blog-roll have themselves many subsequent links. Centrality is achieved because the node is linked to other nodes that are well-connected. A negative coefficient of -0.5 is used to determine power, with the concept of power understood in this test as whether a blog is connected to many blogs without further links themselves. Power is implied because a node that is connected to few other nodes is more dependent on them than if it was connected to many others (Hanneman and Riddle, 2005). The positive coefficient test to determine centrality provided some very different results to both the Freeman's approach tests, with Table

2.5 showing *The Friends of Carbon Dioxide* as the most central. The blogs to which *The Friends of Carbon Dioxide* links on its blog-roll have themselves many subsequent links, indicating that it may be well-attuned to the key nodes in the climate sceptical blogosphere. The negative coefficient test to determine power assigns negative values to well-connected nodes and positive values to weakly connected nodes. In the case of a blogosphere, the results for this test may indicate that high-scoring blogs are serving as key sources of inspiration and information. According to the negative coefficient results (Table 2.6), *The Friends of Carbon Dioxide* is less powerful, only ranking sixth. The blogs *GORE LIED*, and *The Global Warming Heretic* scored in the top 10 results of both the positive and negative coefficient tests.

Table 2.5: Degree centrality (Bonacich's approach) positive coefficient (centrality) results

Rank	Blog	Score	Category	Blog-roll
1	The Friends of Carbon Dioxide	50.48	1	Yes
2	iloveCarbonDioxide.com	27.45	1	Yes
3	The Global Warming Heretic	21.08	1	Yes
4	Impact of Climate Change	20.34	1	Yes
5	hauntingthelibrary	19.54	1	Yes
6	Tory Aardvark	19.53	1	Yes
7	CO2 Insanity	18.96	1	Yes
8	Climate Change Denier	18.88	1	Yes
9	Global Warming	18.81	1	Yes
10	An Honest Climate Debate	17.68	1	Yes

Table 2.6: Degree centrality (Bonacich's approach) negative coefficient (power) results

Rank	Blog	Score	Category	Blog-roll
1	Climate Nonconformist	-430.62	1	Yes
2	Global Shamming	-324.14	1	Yes
3	False Alarm	-280.37	1	Yes
4	The Global Warming Heretic	-222.19	1	Yes
5	Kiwi Thinker	-200.96	1	Yes
6	The Friends of Carbon Dioxide	-192.02	1	Yes
7	Errors in IPCC Science	-182.42	1	Yes
8	Climatequotes.com	-175.84	1	Yes
9	Digging in the Clay	-160.21	1	Yes
10	GORE LIED	-159.55	1	Yes

In order to test the results for degree centrality (as the number of connections may not necessarily indicate the relative importance of a node within a network), a test for betweenness was also conducted. Betweenness centrality is used to highlight those nodes upon which others depend to make connections. In traditional SNA, this is a measure of whether a node is "between" other nodes in a network, for example, how many people depend on an individual actor to make connections with other people. In

the case of a blogosphere, a blog may achieve a high score if it is linked to by many other blogs (thus results for this test are expected to be similar to those for in-degree rating using Freeman's degree centrality). Table 2.7 shows that *WUWT* is an extremely central node according to this test. The results of this test are interpreted against the mean betweenness score. *WUWT* has a score of 3971.52, significantly higher than the mean score of 180.31. As anticipated, there was a large overlap between the results for this test and those for Freeman's in-degree centrality, with six blogs appearing in both sets of results. *Climate Audit*, *ICECAP*, *JoNova* and *No Frakking Consensus* were short-listed based on these results.

Table 2.7: Freeman's betweenness node centrality results

Rank	Blog	Score	Category	Blog-roll
1	Watts Up With That	3971.52	1	Yes
2	ICECAP	2638.08	1	Yes
3	Bishop Hill	1948.08	1	Yes
4	Global Warming Science	1805.80	1	Yes
5	No Frakking Consensus	1790.30	1	Yes
6	GORE LIED	1672.28	1	Yes
7	C3 Headlines	1365.88	1	Yes
8	Climate Audit	1221.18	2	Yes
9	JoNova	1084.35	1	Yes
10	Australian Climate Madness	1016.16	1	Yes

2.6   Analysis

The centrality test results show that nine blogs from the total network of 171 could be considered to be the most central nodes within the climate sceptical blogosphere: *WUWT*, *Bishop Hill*, *Climate Audit*, *GORE LIED*, *ICECAP*, *JoNova*, *No Frakking Consensus*, *The Friends of Carbon Dioxide* and *The Global Warming Heretic*. However, while a blog may appear to be influential as a result of high centrality scores, this position may be illusory, created through mathematical analysis rather than actual influence. Delving deeper is a vital part of good SNA, as the results should not be viewed in isolation, or necessarily meaning that the 'measured relationships and relationship strengths as accurately reflecting the "real" or "final" or "equilibrium" status of the network' (Hanneman and Riddle, 2005: 13) in question. In nearly all respects, apart from all having blog-rolls, they are heterogeneous. *Climate Audit* is a category 2 blog, whereas the remainder are category 1. Four are USA-authored, three in Australia, and one each in Canada and the UK. *WUWT* and *JoNova* receive hundreds of comments per post, whereas *The Friends of Carbon Dioxide* regularly receives either none or fewer than five comments per post. *GORE LIED* and *The Global Warming*

Heretic appear to both be infrequently updated (or retired) which is an important discount factor in the blogosphere, where quick turnaround of information is critical to retain readers' attention and get repeat visits. In order to test the SNA results, reader statistics were employed to indicate the blogs' relative importance to the blogosphere user community (however, it is also important to note that site traffic should not be interpreted as an indicator of credibility *per se*—while site traffic may provide an indication of relative attention, these results only demonstrate site traffic as compared to each other (and not to wider traffic to other websites or blogs) and can in no way indicate how the information contained within each blog is regarded or interpreted). Google's *Ad Planner* was used to estimate site traffic. Very little research is available that compares the accuracy of publicly-accessible (both free and subscription) site-traffic estimation services (Vaughan and Yang, 2013). In the absence of such research, *Ad Planner* was chosen as it yielded the most data on the short-listed blogs as compared to other services. Moreover, it does not provide information for low-traffic websites, thus suggesting that if any of the nine blogs were not tracked, they are unlikely to receive significant traffic. As shown in Table 2.8, only four of the nine blogs appeared in the *Ad Planner* results: *Climate Audit*, *ICECAP*, *JoNova* and *WUWT*. *ICECAP* receives significantly fewer estimated page views per month than the other blogs and was thus excluded from the final analysis.

Table 2.8: Estimated site traffic using Google Ad Planner

Blog	Estimated unique visitors per month	Estimated page views per month
Climate Audit	19,000	200,000
ICECAP	14,000	84,000
JoNova	22,000	200,000
WUWT	140,000	2,100,000

In order to understand why *Climate Audit*, *JoNova* and *WUWT* occupy the most central positions in the climate sceptical blogosphere according to the SNA and site traffic results, thematic content analysis of multiple posts from each blog was performed. Thematic content analysis was chosen as it enables an assessment and subsequent classification of each individual post, focusing in particular on the key thematic preoccupations of the blogger (i.e. what is the content deemed most important to therefore post online), and on how the information is presented and interpreted (i.e. what terminology or language is used in the post/how is the argument framed) (Fereday and Muir-Cochrane, 2006). 20 posts in chronological order dating from 1 March 2012 were identified from each blog, with each post categorised under either

"science", or "policy". The categories of science and policy were chosen as they are the most prevalent underlying themes of climate scepticism identified in the literature in terms of climate sceptical arguments (Rahmstorf, 2005). While such categorisations have also been associated with different motivations behind climate sceptical viewpoints (Hulme, 2009; Washington and Cook, 2011), an investigation of underlying motivations was beyond the scope of this research (and again, served to direct the methodological choice towards manifest thematic analysis as opposed to, for example, discourse analysis). "Science" included all scientifically-related points, including any argument that referenced scientific data or methods, scientific transparency, scientific theories or the role and activities of scientific institutions. No distinction was made between what has been suggested as being 'scientifically legitimate' arguments (Freudenburg and Muselli, 2010: 483) as opposed to 'non-science and pseudoscience' (Cormick, 2011) or the dressing of 'science denial in the trappings of science' (Rosenau, 2012: , p. 567). This is an important point to emphasise, as the aim of this research is not to cast judgement on the validity or legitimacy of the blogs' content, such as the scientific knowledge claims contained within specific posts, but to understand how the choice of topic contributes to a blog's position in the network. As such, it focuses on overtly manifest themes and language, rather than analysis of any latent discourse or identification of motivated reasoning behind specific framings of climate change (Whitmarsh, 2011) (both beyond the scope of this specific piece of research). "Policy" included all discussions that emphasised the politics of, or policy decisions related to, climate change, such as the political appropriateness of mitigation or adaptation policies. While this categorisation may appear to be an overly simplistic binary (particularly given the complex interrelationships between science and policy as outlined above in relation to theories such as post-normal science), it was chosen as a way of most accurately reflecting the *overt* choice of topic made by each blogger. While research has shown that it is very likely that the motivations behind the expression of climate sceptical arguments and opinions relate to particular values, or political or ideological worldviews (McCright and Dunlap, 2000; McCright and Dunlap, 2003; Hulme, 2009; McCright and Dunlap, 2011a; Poortinga et al., 2011; Corner, 2013), the *choice* of scientific language or scientific framings as the vehicle through which climate scepticism is communicated is also important to understand, as it allows for an insight into the issues deemed most pertinent, or indeed most convincing, to the debate in the blogosphere environment. It is thus important to emphasise that it is not the aim of this categorisation system to make "policy" synonymous with an ideologically-motivated scepticism, nor to suggest that "science" is conversely ideologically

independent. Where neither of these categories was an accurate fit, a further category of "other" was used. More detailed sub-themes were also used, including "funding sources" or "transparency" under the overall category of science, and "regulation" or "government agency" under the overall category of policy.

The dominant category across all three blogs was science. 95% of the analysed posts on *Climate Audit* were categorised as science, with the remaining post categorised as other. 50% of the posts on *JoNova* were categorised as science, with the remaining 50% split equally between politics and other. 100% of the posts on *WUWT* were categorised as science. The overall category of science was supplemented by several sub-themes, with discussions of alternative scientific rationales for observed climate variability and extreme weather events, and critiques of techniques and results from mainstream climate science such as computer modelling of surface temperature data particularly prevalent. Distrust of scientists involved in mainstream climate science and associated scientific arguments was also a frequently occurring point of contestation, including claims that mainstream climate scientists' claims were scientifically invalid.

Climate Audit appeared to be predominantly interested in issues of scientific transparency, such as information access, funding sources and scientific integrity. For example, the following excerpt from a post entitled *Schmidt's "Conspiracy Theory"* (16 May 2012) discusses efforts that *Climate Audit* made to access primary data:

> *Wahl and Ammann announced in May 2005 that all our claims were "unfounded". Since our codes were very close and I reconciled them almost immediately, I knew that their verification r2 results would be identical to ours. Again, I was asked to review the paper (though my review was disregarded.) As a reviewer, I asked for the verification r2 results. Wahl and Ammann refused. Rather than rejecting the paper, Schneider terminated me as a reviewer.*

JoNova discusses a broader range of topics (for example, fake gold bars and full-body scanners at airports), yet still has a clear interest in scientifically-related climate sceptical arguments. Key sub-themes included conspiracy theories (predominantly regarding climate scientists) and media behaviour when discussing climate science. For example, in a post entitled *Monbiot—Steal things and be a "democratic" hero* (4 March 2012), referring to journalist George Monbiot, *JoNova* argues that the 'richest of ironies is that Monbiot relies on models and opinions, while the sceptics that he looks

down upon want observations and data, true to the original tenets of the scientific method. Despite not apparently knowing what makes science different from a religion, he calls sceptics "anti-science deniers"'. *WUWT* is extremely prolific, with 190 posts for March 2012 alone; however, the posts analysed had several reoccurring sub-themes under the overall category of science, with a predominant interest in alternative explanations for climate models, temperature data or human-induced climate change, largely in the form of scientifically-based challenges to published science. For example, the following excerpt from *Why William D. Nordhaus Is Wrong About Global Warming Sceptics Being Wrong…* (3 March 2012) disputes mainstream climate science knowledge claims: 'As the Earth's climate continues to not cooperate with their models, the so-called consensus will eventually recognize and acknowledge their fundamental error'. Across all three blogs, the two most prevalent sub-themes identified were a) direct scientifically-based challenges to mainstream climate science, and b) critiques of the conduct of the climate science system, such as individual climate scientists' actions (including issues of transparency) or institutional decision-making. While the latter sub-theme may be understood as related to more "political" understandings of science (such as the relative role of science as a factor in decision-making under controversy), as it is still overtly discussing the organisation of climate science as a whole, it was still categorised as science.

While the three most central blogs focus on scientific framings of the climate debate, it is possible that other, non-central, blogs also have a similar focus and that, instead of being a significant factor in the centrality of these blogs in particular, it is broadly characteristic of the entire climate sceptical blogosphere. To test this, of the 162 blogs not identified as central in any way, 20 were randomly selected, with 20 posts from each blog dated in chronological order from 1 March 2012 subject to thematic content analysis and allocated to one of the three main categories: science, policy or other. Where a blog had more than 50% of its posts allocated to a single category, that category was assigned as the overall theme of the blog. Of the 20 randomly selected blogs, the majority (65%) were categorised as policy, focusing on issues such as energy policies or climate change legislation. For example, of the 20 posts analysed from *Tory Aardvark*, six focused on wind-farm policies, five examined international or UK climate politics, one discussed climate science, and the remaining eight investigated topics as varied as the psychology of climate change fear and the teaching of climate change in schools. 30% of the 20 non-central blogs focused on climate science, using similar arguments and content as was found in the most central blogs, such as discussions of

the authority of climate models or IPCC predictions, with only one blog allocated to the category of other as it was solely preoccupied with the weather-related impacts of climate change.

2.7   Conclusion

This research aimed to identify the climate sceptical blogosphere and its most central nodes, and to investigate whether a focus on particular themes contributed to the positioning of the most central blogs. A blogosphere comprising 171 individual blogs was identified using SNA, with three blogs in particular, *Climate Audit*, *JoNova* and *WUWT*, identified as the most central based on three tests of centrality (Freeman's and Bonacich's approaches for degree centrality and Freeman's betweenness) and site-traffic. While the SNA provided varied results as to which blogs may be considered the most central, the results of one specific measure of centrality, in-degree rating according to Freeman's approach for degree centrality, appear to be particularly relevant. The three blogs identified as the most central are also the top three most linked-to sites according to Freeman's in-degree rating. This suggests that in-degree connectivity may be an important indicator when analysing the centrality of a blogosphere, although further research on different blogospheres is required to test this hypothesis. It does however accord with Bruns et al.'s (2008) contention that a blog with a high number of incoming links may be understood as highly respected by its peers.

The most noteworthy finding of this research however is that the blogs identified as the most central predominantly focus on the scientific element of the climate debate. Regardless of the motivation behind the existence of the climate sceptical opinion, what appears to be the most valued and legitimate way of expressing that opinion within the blogosphere is through the use of scientific themes and language. Within this overall focus, providing a direct scientifically-based challenge to mainstream climate science, or a critique of the conduct of the climate science system (such as individual climate scientists' actions or institutional decision-making) appear to be particularly important themes, thus according most closely with Rahmstorf's (2005) categories of trend or attribution scepticism. The central blogs' overt framing of climate sceptical arguments within the language of contested scientific knowledge claims and critiques of science conduct is interesting for multiple reasons. First, it suggests that the blogosphere is still preoccupied with framing climate change as an

active *scientific* controversy. Whilst multitude scientific uncertainties regarding climate systems still exist, fundamental components of climate science such as the relationship between anthropogenic greenhouse gas emissions and temperature increases are no longer considered contentious within the academic literature (IPCC, 2011; IPCC, 2013). As newspapers such as *The Los Angeles Times* and *The Sydney Morning Herald* refrain from publishing reader letters which deny anthropogenic climate change (Lewis and McEvoy, 2013; Thornton, 2013), it is possible that scientifically-framed climate sceptical arguments may become increasingly rare in traditional mainstream media fora, instead retreating into the unregulated blogosphere environment. Second, it contradicts claims that climate science is 'adrift in the blogosphere' (Schäfer, 2012: 529) because even though few climate scientists themselves blog—and are suggested to mainly focus on addressing the "pseudoscience" suggested as existing within the climate sceptic blogosphere (Schäfer, 2012)—this does not mean that science itself is not an active topic of discussion. Finally, it also suggests that by *not* focusing on, or explicitly identifying, debates regarding the ideological foundation for climate change disagreement, which more explicitly highlights 'attitudes and worldviews…[and] political ideology and personal values' (Poortinga et al., 2011: 1022), the blogosphere may be playing a central role in perpetuating doubt regarding the scientific basis for subsequent climate change policy-making. This conclusion therefore stands somewhat in contrast to the results found by Elsasser and Dunlap (2013) whose analysis of conservative columnists' discussion of climate change shows a strong preoccupation with trend sceptical arguments, yet a concomitant emphasis on connecting the political figure of Al Gore with these arguments.

The expertise that appears to be the most valued in this alternative knowledge network—command of scientific knowledge and willingness to use it to critique mainstream climate science—is thus also different to that valued in other alternative knowledge networks. For example, in the knowledge networks formed by UK mothers in response to the potential threat from the measles, mumps and rubella vaccine, 'personalised framings' (Poltorak et al., 2005: 717) rather than disputes over the scientific evidence were predominant. Thus building on Merritt and Jones' (2000) suggestion of climate sceptics as "agents of persuasion", this research has shown that these central nodes are key protagonists in a process of continual *expert* knowledge de-legitimisation and contestation. Interestingly however, and in opposition to the Cumbrian sheep farmers in Brian Wynne's classic investigation of expertise, these

bloggers do not appear to recognise a 'dependency upon the scientific experts as the certified public authorities on the issue' (Wynne, 1992: 299). It is suggested that these central blogs in particular are not only acting as translators between scientific research and lay audiences, but, in their reinterpretation of existing climate science knowledge claims and critique of scientific institutions, are acting themselves as alternative public sites of expertise for a climate sceptical audience.

Several reasons may explain why scientifically-based challenges to, or reinterpretations of, climate science, as well as arguments that criticise systems of scientific enquiry or quality, are highly valued in this context. These blogs may be regarded as providing more accurate or trustworthy knowledge than exists in mainstream climate science, or indeed is available either as readily or in as detailed a format as in other sources such as the mainstream media (Boykoff, 2013). This rationale would suggest that the 'relevant resource' that Brass (1984: 520) identifies as critical as to why certain nodes become more powerful than others is, in this instance, command of scientific knowledge, in particular, knowledge that attempts to destabilise mainstream science. Bloggers are thus acting as gatekeepers and interpreters in an alternative knowledge network that is running in parallel to the ways in which, for example, scholarly journal editors carry out the same function in the mainstream academic knowledge network (McGinty, 1999). These blogs therefore may be seen to provide a resource upon which scepticism—which, as the literature suggests, is very likely related to processes such as motivated reasoning and disputes of underlying values or worldviews (Heath and Gifford, 2006; McCright and Dunlap, 2011a; Lewandowsky et al., 2012; Boykoff and Olson, 2013)—can be scientifically justified (Cook et al., 2004). It is possible that this contributes to a situation whereby these blogs serve as an "echo chamber", within which users are 'consuming news that mesh with their worldview and ideology' (Boykoff, 2013: 15), and thus contributing to Hoffman's (2011b) concept of a logic schism within the climate debate. Nonetheless, it is important to note that this research has explicitly aimed to avoid judging the validity of the scientific arguments contained within the blogs in question. It has also been outside the scope of this paper to investigate the latent rationales behind the existence of sceptic opinions held by the specific bloggers identified within the network. However, by highlighting how the use of scientific language and framings (i.e. *how* bloggers are talking about climate change, rather than necessarily *why* they are using those framings to make their arguments) is contributing to the relative positioning of blogs in the climate sceptical blogosphere, such as JoNova's reference to arguments of

scientific quality as a means to validate her argument, this paper does aim to contribute to wider debates about the interaction between the public and more traditional forms of expertise (Wynne, 1992; Collins and Evans, 2002; Demeritt, 2006).

This research has also contributed to the literature on online knowledge networks by showing that these central blogs may also be attempting to break open Latour and Woolgar's (1986) "black box" of science, with the lack of deference given to mainstream climate science possibly attributable to the medium of contestation. The internet enables a dramatically different type of social interaction between what Nowotny (1993: 308) terms 'knowledge experts and protoexperts', with the minutiae of the building blocks of scientific argument, particularly visual representations such as graphs and diagrams, laid bare for detailed, and rapid, critique. Ravetz (2012) even goes so far as to argue that the blogosphere has actualised post-normal science, with debates about quality—particularly quality related to scientific work—a central tenet. The freely accessible nature of blogs is also notable, as while there is a movement in academia towards open-access journal publication (Chan, 2004), it is not yet the norm. This is significant as blogs are an increasingly common source of scientific source material for mainstream media (Brumfiel, 2009) and the climate sceptical arguments emphasised in these central blogs likely receive a disproportionately larger audience than is warranted when compared with the knowledge claims made by the majority of mainstream climate science (Boykoff, 2013).

Many opportunities exist for further research using this dataset, including examining discursive links between the blog posts (Bruns et al., 2011), or dialogical analysis when a specific scientific knowledge claim is debated by more than one blog. Investigating the transformation of an issue through this process of debate could point to ways in which participants in the climate debate are framing particular issues of contention. Another extension could be to examine the linkages between climate sceptical and non-sceptical blogs, following the example of Adamic and Glance (2005) who examined linkages between Democrat and Republican political blogs in the run-up to the 2004 USA Presidential election. Finally, it remains unclear what the centrality of these blogs means in terms of their "power" as suggested by Brass (1984), as regards their reach outside beyond the online environment. While blogs in other areas have been suggested as playing an important public agenda-setting role (see for example research by Wallsten (2007) on political blogs in the USA), more research is required that

investigates how the climate sceptical blogosphere may be influencing the wider public debate about climate change.

2.8 References

Adamic LA and Glance N. (2005) The political blogosphere and the 2004 U.S. election: divided they blog. *Proceedings of the 3rd International Workshop on Link Discovery.* Chicago, Illinois: ACM, 36-43.

Antilla L. (2005) Climate of scepticism: US newspaper coverage of the science of climate change. *Global Environmental Change* 15: 338-352.

Bar-Ilan J. (2005) Information hub blogs. *Journal of Information Science* 31: 297-307.

Barabási A-L, Albert R and Jeong H. (2000) Scale-free characteristics of random networks: the topology of the world-wide web. *Physica A: Statistical Mechanics and its Applications* 281: 69-77.

Berryman J. (2006) What defines 'enough' information? How policy workers make judgements and decisions during information seeking: preliminary results from an exploratory study. *Information Research: An International Electronic Journal* 11.

Borgatti SP, Everett MG and Freeman LC. (1999) *UCINET 5 for Windows: Software for social network analysis.* Harvard, MA: Analytic Technologies Inc.

Borgatti SP, Mehra A, Brass DJ, et al. (2009) Network analysis in the social sciences. *Science* 323: 892-895.

Boykoff MT. (2007) From convergence to contention: United States mass media representations of anthropogenic climate change science. *Transactions of the Institute of British Geographers* 32: 477-489.

Boykoff MT. (2013) Public enemy no. 1? Understanding media representations of outlier views on climate change. *American Behavioral Scientist* 57: 796-817.

Boykoff MT and Olson SK. (2013) 'Wise contrarians': A keystone species in contemporary climate science, politics and policy. *Celebrity Studies* 4: 276-291.

Brass DJ. (1984) Being in the right place: A structural analysis ofindividual influence in an organization. *Administrative Science Quarterly* 29: 518-539.

Brumfiel G. (2009) Supplanting the old media? *Nature* 458: 274-277.

Bruns A, Burgess J, Highfield T, et al. (2011) Mapping the Australian networked public sphere. *Social Science Computer Review* 29: 277-287.

Bruns A, Kirchhoff L, Nicolai T, et al. (2008) Discussion paper: Network and concept maps for the blogosphere. QUT Creative Industries.

Caiani M and Wagemann C. (2009) Online networks of the Italian and German extreme right: An explorative study with social network analysis. *Information Communication & Society* 12: 66-109.

Carlson M. (2007) Blogs and journalistic authority. *Journalism Studies* 8: 264-279.

Chan L. (2004) Supporting and enhancing scholarship in the digital age: The role of open access institutional repository. *Canadian Journal of Communication* 29: 277-300.

Chesney T. (2006) An empirical examination of Wikipedia's credibility. *First Monday* 11.

Collins H and Evans R. (2002) The third wave of science studies. *Social Studies of Science* 32: 235-296.

Cook G, Pieri E and Robbins PT. (2004) 'The scientists think and the public feels': Expert perceptions of the discourse of GM food. *Discourse & Society* 15: 433-449.

Cope B and Kalantzis M. (2009) The role of the internet in changing knowledge ecologies. *Arbor Clencia, Pensamlento y Cultura* 737: 521-530.

Cormick C. (2011) Why clever people believe in silly things. *COSMOS.* Australia: COSMOS Media Ltd. Available at https://cosmosmagazine.com/life-sciences/why-clever-people-believe-silly-things.

Corner A. (2013) A new conversation with the centre-right about climate change: Values, frames and narratives. London: Climate Outreach and Information Network.

Corner A, Whitmarsh L and Xenias D. (2012) Uncertainty, scepticism and attitudes towards climate change: Biased assimilation and attitude polarisation. *Climatic Change* 114: 463-478.

Crompton H. (2007) Mode 2 knowledge production: Evidence from orphan drug networks. *Science and Public Policy* 34: 199-211.

Culler J and Lamb K. (2003) *Just being difficult? Academic writing in the public arena.* Stanford: Stanford University Press.

Dautrich K and Barnes C. (2005a) *Freedom of the press survey: General population 2005.* University of Connecticut, Department of Public Policy. Available at http://importance.corante.com/archives/UCONN_DPP_Survey_GenPop.pdf.

Dautrich K and Barnes C. (2005b) *Freedom of the press survey: Journalists 2005.* University of Connecticut, Department of Public Policy. Available at: http://importance.corante.com/archives/UCONN_DPP_Survey_Journalists.pdf.

Daviter F. (2007) Policy framing in the European Union. *Journal of European Public Policy* 14: 654-666.

Demeritt D. (2006) Science studies, climate change and the prospects for constructivist critique. *Economy and Society* 35: 453-479.

Donald R. (2011) *Cool dudes and libtards: How online incivility, polarisation and politicisation are influencing climate science and policy.* (Master of Arts), School of Oriental and African Studies, University of London, London.

Douglas RM. (2009) The green backlash: Scepticism or scientism. *Social Epistemology* 23: 145-163.

Eagle L, Case P and Low D. (2012) Connecting rather than confusing: Climate change communication. *Australian & New Zealand Marketing Academy Conference 2012.* Adelaide. Available at: http://researchonline.jcu.edu.au/24194/.

Elsasser SW and Dunlap RE. (2013) Leading voices in the denier choir: Conservative columnists' dismissal of global warming and denigration of climate science. *American Behavioral Scientist* 57: 754-776.

Etling B, Kelly J, Faris R, et al. (2010) Mapping the Arabic blogosphere: Politics and dissent online. *New Media & Society* 12: 1225-1243.

Farrell H and Drezner DW. (2008) The power and politics of blogs. *Public Choice* 134: 15-30.

Fereday J and Muir-Cochrane E. (2006) Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development *International Journal of Qualitative Methods* 5: 80-92.

Freudenburg WR and Muselli V. (2010) Global warming estimates, media expectations, and the asymmetry of scientific challenge. *Global Environmental Change* 20: 483-491.

Funtowicz SO and Ravetz JR. (1993) Science for the post-normal age. *Futures* 25: 739-755.

Gavin N and Marshall T. (2011) Mediated climate change in Britain: Scepticism on the web and on television around Copenhagen. *Global Environmental Change* 21: 1035-1044.

Gibbons M, Limoges C, Nowotny H, et al. (1994) *The new production of knowledge: The dynamics of science and research in contemporary societies,* London: Sage.

Guimaraes RdP. (2012) Cooling up: The interconnected public sphere and the "science" of climate denial. *The Fletcher School of Law and Diplomacy.* Boston: Tufts University, 57.

Gulbrandsen LH. (2008) The role of science in environmental governance: Competing knowledge producers in Swedish and Norwegian forestry. *Global Environmental Politics* 8: 99-122.

Hanneman RA and Riddle M. (2005) *Introduction to social network methods.* Riverside, CA: University of California, Riverside.

Hannigan J. (2006) *Environmental sociology,* Oxford: Routledge.

Harnad S. (1998) The invisible hand of peer review. *Nature Web Matters.* Available at: http://www.nature.com/nature/webmatters/invisible/invisible.html.

Heath S, Fuller A and Johnston B. (2009) Chasing shadows: Defining network boundaries in qualitative social network analysis. *Qualitative Research* 9: 645-661.

Heath Y and Gifford R. (2006) Free-market ideology and environmental degradation: The case of belief in global climate change. *Environment and Behavior* 38: 48-71.

Herring SC, Kouper I, Paolillo JC, et al. (2005) Conversations in the blogosphere: An analysis "from the bottom up". *Proceedings of the 38th Annual Hawaii International Conference on System Sciences (HICSS'05).* IEEE Computer Society.

Hobson K and Niemeyer S. (2012) "What sceptics believe": The effects of information and deliberation on climate change scepticism. *Public Understanding of Science* 22: 396-412.

Hoffman A. (2011a) The culture and discourse of climate skepticism. *Strategic Organization* 9: 1-8.

Hoffman A. (2011b) Talking past each other? Cultural framing of skeptical and convinced logics in the climate change debate. *Organization & Environment* 24: 3-33.

Hookway N. (2008) `Entering the blogosphere': Some strategies for using blogs in social research. *Qualitative Research* 8: 91-113.

Hsu CL and Lin JCC. (2008) Acceptance of blog usage: The roles of technology acceptance, social influence and knowledge sharing motivation. *Information & Management* 45: 65-74.

Hulme M. (2009) *Why we disagree about climate change: Understanding controversy, inaction and opportunity,* Cambridge: Cambridge University Press.

IPCC. (2011) Summary for policymakers In: Field CB, Barros V, Stocker TF, et al. (eds) *Intergovernmental Panel on Climate Change special report on managing the risks of extreme events and disasters to advance climate change adaptation.* Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

IPCC. (2013) Climate change 2013: The physical science basis. Working Group I contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. In: Stocker TF, Qin D, Plattner G-K, et al. (eds) *IPCC Fifth Assessment Report.* Cambridge: Cambridge University Press.

Jacques PJ, Dunlap RE and Freeman M. (2008) The organisation of denial: Conservative think tanks and environmental scepticism. *Environmental Politics* 17: 349-385.

Johnson TJ and Kaye BK. (2004) Wag the blog: How reliance on traditional media and the Internet influence credibility perceptions of Weblogs among blog users. *Journalism & Mass Communication Quarterly* 81: 622-642.

Kahan DM, Jenkins-Smith H and Braman D. (2011) Cultural cognition of scientific consensus. *Journal of Risk Research* 14: 147-174.

Koteyko N, Jaspal R and Nerlich B. (2012) Climate change and 'climategate' in online reader comments: A mixed methods study. *The Geographical Journal* 179: 74-86.

Latour B and Woolgar S. (1986) *Laboratory life: The construction of scientific facts,* Princeton, NJ: Princeton University Press.

Lawrence S and Giles CL. (1999) Accessibility of information on the web. *Nature* 400: 107-109.

Lewandowsky S, Oberauer K and Gignac G. (2012) NASA faked the moon landing - therefore (climate) science is a hoax: An anatomy of the motivated rejection of science. Perth: University of Western Australia.

Lewis J and McEvoy M. (2013) Climate change: A note from our Letters editors. *The Sydney Morning Herald.* 21 October 2013 ed. Sydney.

Lowrey W. (2006) Mapping the journalism–blogging relationship. *Journalism* 7: 477-500.

Martin B and Richards E. (1995) Scientific knowledge, controversy, and public decision-making In: Jasanoff S, Markle GE, Petersen JC, et al. (eds) *Handbook of science and technology studies.* Newbury Park, CA: Sage, 506-526.

McCright AM and Dunlap RE. (2000) Challenging global warming as a social problem: An analysis of the conservative movement's counter-claims. *Social Problems* 47: 499-522.

McCright AM and Dunlap RE. (2003) Defeating Kyoto: The conservative movement's impact on U.S. climate change policy. *Social Problems* 50: 348-373.

McCright AM and Dunlap RE. (2011) Cool dudes: The denial of climate change among conservative white males in the United States. *Global Environmental Change* 21: 1163-1172.

McGarity TO. (2003-2004) Our science is sound science and their science is junk science: Science-based strategies for avoiding accountability and responsibility for risk-producing products and activities. *University of Kansas Law Review* 52: 897-938.

McGinty S. (1999) *Gatekeepers of knowledge: Journal editors in the sciences and the social sciences,* Westport, CT: Bergin & Garvey.

Merritt JQ and Jones PC. (2000) Science and environmental decision making: The social context. In: Huxham M and Sumner D (eds) *Science and environmental decision making.* Harlow: Pearson Education Ltd, 63-93.

Merton RK. (1973 [1942]) The normative structure of science. In: Merton RK (ed) *The sociology of science: Theoretical and empirical investigations.* London: The University of Chicago Press, 267-278.

Moe H. (2011) Mapping the Norwegian blogosphere: Methodological challenges in internationalizing internet research. *Social Science Computer Review* 29: 313-326.

Nerlich B. (2010) 'Climategate': Paradoxical metaphors and political paralysis. *Environmental Values* 19: 419-442.

Newman MEJ, Watts DJ and Strogatz SH. (2002) Random graph models of social networks. *Proceedings of the National Academy of Sciences of the United States of America* 99: 2566-2572.

Niederer S. (2013) 'Global warming is not a crisis!': Studying climate change skepticism on the Web. *European Journal of Media Studies* 3.

NM Incite. (2012) Buzz in the blogosphere: millions more blogs and blog readers. In: NM Incite (ed) *Newswire.* Available at: http://www.nielsen.com/us/en/newswire/2012/buzz-in-the-blogosphere-millions-more-bloggers-and-blog-readers.html.

Nowotny H. (1993) Socially distributed knowledge: Five spaces for science to meet the public. *Public Understanding of Science* 2: 307-319.

Nowotny H, Scott P and Gibbons M. (2003) Introduction: 'Mode 2' revisited: The new production of knowledge. *Minerva* 41: 179-194.

Oreskes N and Conway EM. (2010) *Merchants of doubt: How a handful of scientists obsured the truth on issues from tobacco smoke to global warming,* New York: Bloomsbury Press.

Painter J. (2011) *Poles apart: The international reporting of climate scepticism,* Oxford: University of Oxford.

Painter J and Ashe T. (2012) Cross-national comparison of the presence of climate scepticism in the print media in six countries, 2007-10. *Environmental Research Letters* 7: 044005.

Pielke J, R.A. (2007) *The honest broker: Making sense of science in policy and politics,* Cambridge: Cambridge University Press.

Poltorak M, Leach M, Fairhead J, et al. (2005) 'MMR talk' and vaccination choices: An ethnographic study in Brighton. *Social Science & Medicine* 61: 709-719.

Poortinga W, Spence A, Whitmarsh L, et al. (2011) Uncertain climate: An investigation into public scepticism about anthropogenic climate change. *Global Environmental Change* 21: 1015-1024.

Rahmstorf S. (2005) The climate sceptics. In: Re M (ed) *Weather catastrophes and climate change: is there still hope for us?* Munich: Munich Re, 76-83.

Ravetz JR. (2012) The significance of the Hamburg workshop: Post-normal science and the maturing of science *Nature and Culture* 7: 133-150.

Rogers R. (2012) Mapping and the politics of web space. *Theory, Culture & Society* 29: 193-219.

Rogers R and Marres N. (2000) Landscaping climate change: A mapping technique for understanding science and technology debates on the World Wide Web. *Public Understanding of Science* 9: 141-163.

Rosenau J. (2012) Science denial: A guide for scientists. *Trends in Microbiology* 20: 567-569.

Schäfer MS. (2012) Online communication on climate change and climate politics: A literature review. *Wiley Interdisciplinary Reviews: Climate Change* 3: 527-543.

Schmidt A, Ivanova A and Schäfer MS. (2013) Media attention for climate change around the world: A comparative analysis of newspaper coverage in 27 countries. *Global Environmental Change* 23: 1233-1248.

Sun WJ and Qiu HM. (2008) A social network analysis on blogospheres. In: Lan H (ed) *2008 International Conference on Management Science & Engineering.* New York: IEEE, 1769-1773.

Technorati. (2013) *Science blogs*. Available at: http://www.technorati.com/blogs/directory/science/.

Thornton P. (2013) On letters from climate-change deniers. *The Los Angeles Times.* 8 October 2013 ed. Los Angeles.

Tremayne M. (2007) Blogging, citizenship, and the future of media. Oxford: Routledge.

Tremayne M, Zheng N, Lee JK, et al. (2006) Issue publics on the web: Applying network theory to the war blogosphere. *Journal of Computer-Mediated Communication* 12: 290-310.

Vaughan L and Yang R. (2013) Web traffic and organization performance measures: Relationships and data sources examined. *Journal of Informetrics* 7: 699-711.

Wallsten K. (2007) Agenda setting and the blogosphere: An analysis of the relationship between mainstream media and political blogs. *Review of Policy Research* 24: 567-587.

Washington H and Cook J. (2011) *Climate change denial: Heads in the sand,* London: Earthscan.

Watts DJ. (1999) Networks, dynamics, and the small-world phenomenon. *American Journal of Sociology* 105: 493-527.

Wei Lai JG. (2009) A systematic approach to visualize blogs network based on clustering. *2009 Fourth International Conference on Computer Sciences and Convergence Information Technology.* Seoul: IEEE Computer Society, 1190-1195.

Whitmarsh L. (2011) Scepticism and uncertainty about climate change: Dimensions, determinants and change over time. *Global Environmental Change* 21: 690-700.

Wynne B. (1992) Misunderstood misunderstanding: Social identities and public uptake of science. *Public Understanding of Science* 1: 281-304.

Zuckerman H and Merton RK. (1971) Patterns of evaluation in science: Institutionalisation, structure and functions of the referee system. *Minerva* 9: 66-100.

2.9   Web references

Australian TEA Party, http://austeaparty.com.au/web/, accessed 22 May 2013.

Bishop Hill, http://bishophill.squarespace.com, accessed 23 May 2013.

Climate Audit, http://climateaudit.org, accessed 9 May 2013.

Climate Depot, http://www.climatedepot.com, accessed 23 May 2013.

Climate etc., http://judithcurry.com, accessed 23 May 2013.

Climate Scum, http://theclimatescum.blogspot.co.uk, accessed 16 August 2013.

DeSmogBlog, http://www.desmogblog.com, accessed 22 May 2013.

Google Ad Planner, https://www.google.com/adplanner/, accessed 16 August 2013.

GORE LIED, http://algorelied.com, accessed 21 May 2013.

ICECAP, http://www.icecap.us, accessed 23 May 2013.

JoNova, http://joannenova.com.au, accessed 22 May 2013.

Met Office News Blog, http://metofficenews.wordpress.com, accessed 22 May 2013.

No Frakking Consensus, http://nofrakkingconsensus.com, accessed 23 May 2013.

The Climate Scum, http://theclimatescum.blogspot.co.uk, accessed 2 August 2013.

The Friends of Carbon Dioxide, http://friendsofco2.blogspot.co.uk, accessed 23 May 2013.

The Global Warming Heretic, http://agw-heretic.blogspot.co.uk, accessed 23 May 2013.

Tory Aardvark, http://toryaardvark.com, accessed 16 August 2013.

Watts Up With That, http://wattsupwiththat.com, accessed 23 May 2013.

WebCrawler, http://www.webcrawler.com, accessed 28 May 2013.

Chapter 3. Labelling opinions in the climate debate: A critical review

Abstract

Labels play an important role in opinion formation, helping to actively construct perceptions and reality, and place individuals into context with others. As a highly complex issue, climate change invites a range of different opinions and dialogues about its causes, impacts, and action required. However, the polarised labels used in the climate change debate, such as sceptic or alarmist, are both reflecting and helping to frame the debate as antagonistic and combative. This paper critically reviews the literature on climate opinion labels, and the efforts taken within an academic context to categorise differences, create new taxonomies of more detailed sub-labels, or create or argue for the use of new labels such as denier or contrarian. By drawing on research on typologies of climate opinions, problems with labelling constructs and discussions around context and the implications for science-policy dialogue, we argue that climate labels, both as constructed in the academic literature, and as applied in science and policy debates, are serving to isolate, exclude, ignore, and dismiss claims-makers of all types from constructive dialogue. It suggests that context has been inadequately considered by the literature and that an emphasis on labels is accentuating division and diverting attention away from a focus on underlying motivations, which may be more conducive toward increasing public understanding and encouraging communication across this polarised debate.

Keywords: climate change, scepticism, opinion, categorisation, label, motivation

3.1 Introduction

Categorising and grouping people is a fundamental part of the human cognitive process (Watts and Dodds, 2007). Not only does it aid in the understanding and assimilation of the vast amount of information humans face each day, but it is essential to the ability to learn, understand the world and effectively process information (Piaget and Inhelder, 1973; Bowker and Star, 1999). Therefore, creating a categorisation system to identify different opinions held about climate change appeals as it enables a way to structure understandings of these opinions and to place oneself in context with others. Labels act

as short-hand descriptors for these different categories, evoking meaning(s) and interpretation in the mind of both the user and listener (Dutton and Jackson, 1987). They can thus be understood as subconscious interpretive devices which help to frame perceptions of the category in question (recalling Goffman's (1974) seminal work on frames as schematas of interpretation). Labels are increasingly being recognised as important because, as Parmar (2014) suggests, by acting as discursive elements, they are understood as able to actively *construct* reality, rather than just reflect it. Dutton and Jackson (1987: 77) explain that 'categories are engaged by using linguistic labels' and once labels are applied, they can therefore 'initiate a categorization process that affects the subsequent cognitions and motivations' of those involved.

In the context of climate change, labels are applied to people (rather than for example, to issues) and act as short-hand descriptors which reflect individual or group opinions about climate change. They also predominantly reflect arguments made about climate change (e.g. its scientific veracity or whether policy measures are necessary or appropriate) rather than the motivations behind the formation of these opinions. The majority of the literature in this area, interestingly, is largely silent in terms of rationale as to why categories and labels are deemed necessary in this context. Where arguments are made, the justification behind the need for categorisation and/or labelling appears mostly as a means to make sense of the multitude of arguments expressed about climate change. However, scholars also tend to focus on constructing labels without consideration for their use and value beyond the academic environment (for example at the science-policy interface, and/or their impact on public framing and understanding of climate change).

Research on climate opinions and labels also has a propensity to assess public perceptions of climate change and the extent to which the subsequently constructed labels are robust (Hobson and Niemeyer, 2012). Whilst some work calls for a clear distinction between, for example, types of scepticism, others conclude that the public does not distinguish between these different types of scepticism(Poortinga et al., 2011), begging the question of the impact and value of such labelling constructs. Insights from Kahan et al. (2011) in contrast, provide an approach focusing on underlying values and worldviews, identifying two key categories of risk perception, namely hierarchical-individualistic and egalitarian-communitarian. What is valuable about this approach, and which is not widespread across the literature, is that it is more attuned to motivations, and hence stops short of ascribing polarising labels to

individuals who fit within these categories. This insight from the theory of risk perception thus provides a platform from which categorisation leads to constructive dialogue, as opposed to polarised labelling which influences public perceptions of a highly antagonistic debate.

Indeed, what also appears to be particularly noteworthy in the context of climate change is not just that labels appear in abundance, but how they also both reflect *and* help to construct this dualistic, antagonistic debate between polarised adversaries (Washington and Cook, 2011). In other situations of scientific or public policy controversy, such as debates over vaccination or genetically modified foods, while labels exist (such as "anti-vaxxers") labelling practices in the climate debate appear to be somewhat unique in that the labels used to describe opinions about climate change solely represent positions at the opposite ends of the debate, and in so doing, divide those labelled into two polarised camps.

Labels also seem to be used by all actors involved, from the climate science community (Lahsen, 2013), to policy-makers (Thornsby, 2014) and media outlets (Painter, 2011; Boykoff, 2013), through to commentators as varied as NGOs or lobbying bodies (Singer, 2008; Greenpeace USA, 2013), bloggers (Delingpole, 2012; Lewandowsky et al., 2013c; Sharman, 2014) or social scientists (Turnpenny, 2012) (although the contexts in which different labels are used, as well as by whom and of whom, varies considerably and will be discussed later in more detail). A possible reason for this is the extraordinarily high stakes of the climate debate: current policy decisions will have extremely significant implications for both present and future generations (IPCC, 2011). It evokes many salient issues that are touchstones for strong emotional responses, such as the role of government (Holbrook and Briggle, 2013; Ingold and Gschwend, 2013; Kane, 2013), and thus it is unsurprising that correspondingly intense viewpoints about climate change exist, for example, by those who feel disempowered by current climate change-related decision-making processes (Poortinga et al., 2011). This labelling exercise translates into confused public understanding of climate change: that it is an issue dominated by debate, contention (Anderegg and Goldsmith, 2014) and fraught with polarised opinions, a phenomenon heavily influenced by media coverage of the issue (Leiserowitz et al., 2013b). While it is unclear whether this polarisation of labels is a *product of* the political polarisation inherent in the climate debate (Antonio and Brulle, 2011; McCright and Dunlap, 2011b) or whether the labels are actually *causing* this division (as may be the case following the argument of Parmar

above), or even whether they combine together in a self-reinforcing feedback loop, their ubiquitous presence in the debate makes them worthy of attention.

This paper reviews research from the social sciences (predominantly geography, sociology and psychology) on (i) typologies of climate opinions, (ii) problems with labelling constructs and (iii) discussions around context and the implications for science-policy dialogue. An analysis of over 120 articles addressing climate opinions through terms such as "climate sceptic", "climate denier", "climate contrarian", was conducted for the first aim and wider terms such as "climate communication", "framing" and "science-policy" were used to identify relevant literature for the second and third. The paper then identifies how and why labelling constructs in the climate debate have become so problematic, including how they can help to dictate the nature of dialogue by validating group polarisation (Hoffman, 2011a) and creating a perpetual cycle of disengagement as opposing groups are stereotyped behind fixed labels (Whitmarsh, 2011). We also suggest that context has been inadequately considered by the literature and conclude with a call for the research community to think more critically about how an emphasis on underlying rationales and motivations may allow a more productive dialogue to occur. The academic literature is important to address because it has long been recognised that it can play an important role in influencing and legitimising policy formation (Weiss, 1980; Walt, 1994). It is critical that policy-makers continue to use the academic literature as an evidence base, therefore it is also vital that researchers are attentive to the ways in which their use of, and focus on labels in the climate debate may not be contributing constructively towards a more inclusive dialogue about climate change. It is important to note that because of this focus, we are unable to make any definitive statements about the origin of these labels in other contexts beyond academia, nor speculate as to the application of, or motivations behind the use of different labels by the various actors involved in the debate (however we do suggest that future research is needed to address this deficit).

3.2 Labelling in the climate debate

3.2.1 Sceptical voices

Those who express "ambivalence", "attitudinal uncertainty", "dissonance" or "cynicism" about mainstream climate science and/or the need for mitigation or adaptation climate policy are most commonly referred to in the climate debate as sceptics, deniers or contrarians (Poortinga et al., 2011; Corner et al., 2012). We define mainstream climate

science as the scientific position on climate change as expressed in the Intergovernmental Panel on Climate Change's (IPCC) Fourth and Fifth Assessment Reports on the Science of Climate Change (Section 2: Causes of change), published in 2007 and 2013 respectively. The first occurrence of these labels in relation to climate change appears to have been in 1989 with the label greenhouse sceptic (based on Nerlich's analysis of English language newspapers listed in Nexis (Nerlich, 2014) using the search terms "greenhouse sceptic", "global warming sceptic", "climate sceptic", "climate change sceptic", "climate change denier" and "climate change contrarian"). By the late 1990s, Nerlich finds that this label was overtaken by global warming sceptic as the most common term up until 2005, after which point the discursive turn away from global warming and towards climate change occurred (Luntz, 2002) and climate change sceptic became the most commonly used label. However while overall the label sceptic is the most common, peaking at 2246 mentions in 2009, the label denier is also increasingly prevalent and was the most common label found in 2013 (over 1500 mentions).

Scepticism, as part of the scientific process, is a 'systematic form of continued informed questioning' (Bryce and Day, 2013: 606) which requires the investigator to doubt the truth of an assertion that is not supported by reproducible evidence. It implies seeking the truth, distancing oneself from personal dogma and thoroughly examining findings and conclusions (Washington and Cook, 2011). A central tenet of good scientific practice is thus demonstrating scepticism which 'starts with an open mind, weighs evidence objectively and demands convincing evidence before accepting any claim. It contributes to the debate and forms the intellectual cornerstone of scientific enquiry' (Kemp et al., 2010: 673). In relation to environmental issues, the notion of scepticism has a long history and is not limited to its more recent association with climate change (see for example its use in the context of chemical carcinogenesis nearly 40 years ago (Maltoni, 1976)). More recently Jacques (2009: 1) defined environmental scepticism as 'a counter-movement built on the premise that global environmental changes have been grossly exaggerated, misguided or maliciously fabricated'. This definition is however inadequate in the case of climate change as it fails to critically unpack a number of questions such as which elements have been exaggerated, what are the motivations for such fabrication, and what is the strength with which such views are held? The impreciseness of nomenclature has been recognised, with Hobson and Niemeyer (2012: 397) arguing that 'within modern public discourse, [climate] scepticism stands more for a broader suite of positions and rationales for which no

singular definition exists'. Thus scepticism may therefore, in the context of climate change, have significantly and potentially permanently shifted beyond its original definition as a fundamental scientific tenet.

Climate sceptic is also a problematic label in that it can be used to suggest a normative position whereby those who question the findings of the majority may be regarded as either 'stupid, crazy or evil' (Aronson, 2008: 123). Corner et al. (2012) have argued that the use of the label has given scientific scepticism a "bad name" as the ideologies and experiences of self-proclaimed climate sceptics are hugely variable and being labelled as a sceptic, or labelling oneself in such a manner, can become a form of self-identity and thereby difficult to change (Hobson and Niemeyer, 2012). Consequently, expressions of opinion, which within the scientific community would be regarded as a constructive form of scepticism (such as seen within the peer review process (Weller, 2001)), may be at risk if this automatically invites the ascription of the label climate sceptic and its associated connotations. In light of these challenges, research effort has been directed into better understanding climate change scepticism. In so doing, two main avenues have been followed in the academic literature: to create more detailed taxonomies of labels, or, to create new, or justify the use of, alternative labels (Figure 3.1).
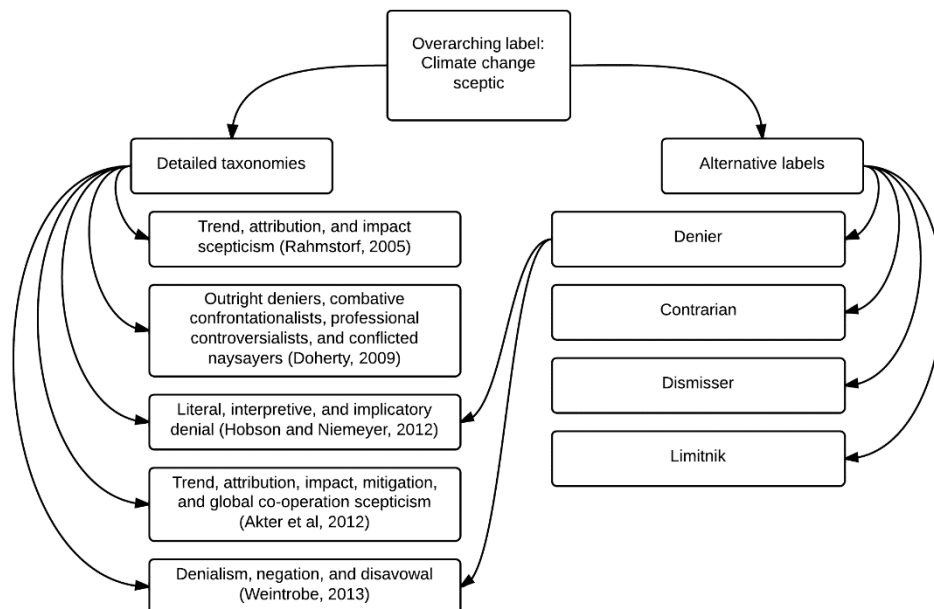
Figure 3.1: Main avenues taken within the literature to better understand climate scepticism

Detailed categories

Rahmstorf (2005) was the first to group sceptical arguments into labelled categories, identifying a taxonomy of trend, attribution and impact sceptics. *Trend sceptics* reflect those who claim that climate change is fictional, often denying the existence of climate change outright, including basic greenhouse gas (GHG) feedback mechanisms. *Attribution sceptics* agree to the existence of climate change but question its anthropogenic cause, or deny that climate change is resulting in temperature increases. *Impact sceptics* also agree that climate change is occurring, but fail to see the consequences as problematic and may also believe that the impact of a warmer climate will be beneficial. This final category, also referred to by Lahsen (2008) as "backlash actors", includes those who argue *for* climate change, feeling it will have positive repercussions, therefore negating the necessity of mitigative action. Rahmstorf's description and categorisation of arguments was innovative for its time. It pioneered an abundance of research seeking to further explore the characteristics of those expressing sceptical arguments, as well as to better understand how these opinions are expressed both in scientific contexts and in wider public environments (Islam et al., 2013). Its simplicity and linearly straightforward nature also appeals to our cognitive habit to categorise and distinguish groups uniformly and concisely. However, Rahmstorf's categories have been criticised as failing to capture the full variety and intersection of opinions which exist in reality. For example, Poortinga et al. (2011) employed Rahmstorf's categories to understand British scepticism and demonstrated that sceptic arguments among the public are strongly interrelated and not clear-cut, as while they are often rooted in an individual's norms and values, they can be flexible and are not necessarily concretely fixed. Moreover, whereas Rahmstorf argued that as 'warming is now evident even to laypeople, the trend sceptics are a gradually vanishing breed' (2005: 77), the continued evidence of trend scepticism, particularly in online environments (Loveys, 2010; Sharman, 2014) challenges this claim.

As a result, more detailed taxonomies of labels have been created, with, for example, Doherty (2009) building on Rahmstorf's foundation and identifying four types of sceptics: (i) *outright deniers*, who claim the IPCC and the science used is simply wrong; (ii) *combative confrontationists*, who automatically assume a position in opposition to any major consensus; (iii) *professional controversialists*, who assume a contrary position in order to appear more significant in dominant discourse and (iv) *conflicted naysayers*, who think climate change is/may be occurring, but feel a sense of loyalty to their career industry (oil, coal etc.) and therefore do not protest. Another effort was

made by Hobson and Niemeyer (2012) who identified five discourses of climate scepticism (*emphatic negation*, *unperturbed pragmatism*, *proactive uncertainty*, *earnest acclimatisation*, and *noncommittal consent*) as well as a variety of different categories using two axes of issue dimension and nature of scepticism. These categories, including associated labels such as *deep scepticism* and *epistemic impact scepticism*, reflect components such as the nature of the opinion (i.e. how deeply held it is) and its epistemic uncertainty (i.e. how certain they are). Akter et al. (2012) returned to Rahmstorf's original taxonomy, but added two additional categories of *mitigation scepticism* (how effective mitigation policies will be) and *global cooperation scepticism* (how likely it is that other countries will reduce their emissions). More recently, Capstick and Pidgeon (2013) identify *epistemic scepticism*, referring to scepticism about the physical existence of climate change, and *response scepticism*, referring to doubts about climate change policy.

New labels

Taking the opposing route, that of creating or applying new labels in their entirety, has been suggested as a more accurate way of identifying the arguments involved as well as better reflecting the underlying rationales of different actors within the debate (Washington and Cook, 2011). The two most commonly used alternative labels in the literature are denier and contrarian (while other terms, such as dismisser/ive or limitnik (Nordhaus, 1994; Maibach et al., 2009; Leiserowitz et al., 2013a) have been suggested, they are significantly less prevalent in scholarly as well as in public discourse). To ascribe the label of climate change denier implies a categorical disregard of the overwhelming majority of the scientific literature that argues that Earth's climate is changing as a result of human GHG emissions. Different rationales exist as to the existence of denial. Specter (in Washington and Cook, 2011: 3, emphasis added) suggests that denial is the replacement of 'rigorous and open-minded scepticism of science with the inflexible certainty of *ideological* commitment'. McCright and Dunlap (2000) have made a similar point, suggesting that it is associated with a particular political viewpoint, and Washington and Cook (2011: 89) concurring that a reluctance to change minds or accept the mainstream scientific position is the result of not liking 'the political views held by those advocating action on global warming'. Such arguments suggest that denial is thus critically different to scepticism and that much of what is currently labelled as climate change scepticism, particularly in popular discourse, ought to actually be re-labelled as denial. Indeed, Kemp et al. (2010: 673)

suggest that making the distinction between denial and scepticism is important as the former 'erodes public understanding of the issue and undermines trust in scientists...' and most importantly, '[c]onviction drives denial as opposed to evidence-driven scepticism'.

Weintrobe (2013) suggests that a key reasoning behind climate change denial is that climate change is too worrisome a topic—if it were to be real, significant lifestyle and other changes would become necessary which may not be desirable. Denial therefore incorporates attitudinal uncertainty, understood as 'a lower subjective sense of conviction or validity as to whether climate change 'really' exists, is caused by human activity, and/or will have major impacts' (Poortinga et al., 2011: 1016). The idea of denial of scientific findings is particularly interesting, and Kalichman (2009: 1) makes an interestingly self-reflexive statement in his examination of AIDS denial. He describes how he as a scientist finds denial 'easy to ignore' and that he can dismiss deniers as a small group of troublemakers. It is also regarded as the most contentious of the labels, regarded by some as necessary to emphasise the potentially very serious opposition to climate change policy implementation (Washington and Cook, 2011), and obstructive by others, as its reference to Holocaust denial brings a 'moralistic tone into the climate change debate that we would do well to avoid' (O'Neill and Boykoff, 2010: E151).

The other most commonly used label, contrarian, refers to 'a person who opposes or rejects popular opinion' (Oxford English Dictionary, 2013). Although less prevalent in mainstream public discourse than sceptic or denier, it has been used within the climate debate to emphasise those who actively choose to take an opposing point of view and publicly criticise mainstream climate science and policy. It has been suggested that contrarians often have financial support from fossil fuel industry organisations or conservative think tanks, and thus have a motivated rationale for their vocal opposition (McCright, 2007). O'Neill and Boykoff (2010) describe climate contrarians as those who have ideological motivations for their opinion, but explicitly exclude those who are 'thus far unconvinced by the science and individuals who are unconvinced by proposed solutions' (Boykoff, 2013: 8). This interpretation implies a deliberate decision to take an opposing view to the mainstream based on pre-existing ideologies and opinions on climate change, or indeed on any topic where a consensus position has been identified. It foreshadows Lewandowsky et al.'s (2013a: 1) finding that not only are free-market worldviews 'an important predictor of the rejection of scientific findings that have potential regulatory implications, such as climate science', but that

rejection of scientific propositions are, in general, associated with those who endorse conspiracy theories. This includes the idea that inconvenient scientific conclusions, such as those which may require regulation or behavioural change, are a hoax.

Some attempts have been made to mix taxonomies and the creation of new labels, mostly in terms of providing sub-categories for denial. For example, Weintrobe (2013), mainly focusing on psychological elements, identifies three forms of climate denial (*denialism, negation* and *disavowal*). Hobson and Niemeyer (2012: 398) take Cohen's (2001) typology of denial and apply it to climate change. In this interpretation, *literal denial* means that 'climate change is not happening', *interpretive denial* is closer to climate scepticism in that it 'encompasses rationales like "it may be happening but is caused by natural cycles/is not that big of a deal"', and *implicatory denial* suggests that climate change is either too distant a phenomenon to care about personally, or too large an issue for a single person to change (Hamilton, 2010). This typology is built on to create five labelled categories of denier: (i) *emphatic negaters* who claim the science is too uncertain to authoritatively claim that climate change is happening; (ii) *unperturbed pragmatics* who do not deny climate change *per se* but do reject the idea of fixed policies aimed at mitigating climate change and feel the cost would outweigh the benefits; (iii) *proactive uncertains*, a broad category which shares elements with the other four identified—they doubt the existence of climate change and are indifferent to policies; (iv) *earnest acclimatisers* who question the cause of climate change and believe in a natural origin of increasing CO_2 levels; and (v) *non-committal consenters* who question the science pertaining to the causes and consequences of climate change.

Alarmist voices

Most often used to identify those at the other end of the polarised climate debate, the other most prevalent group of labels includes alarmist, warmist, believer or catastrophist (Risbey, 2008; Smith, 2012). These appear to be employed almost exclusively by those themselves labelled as sceptics, deniers or contrarians to identify individuals who agree with mainstream climate science and/or the need for mitigation or adaptation climate policy (with some labels such as catastrophist or warmist applied to those who are particularly vocal in their agreement). While these labels do appear in the academic literature to varying degrees they have not been subject to anywhere near the same degree of critical attention as have labels such as sceptic or denier

(noting nonetheless some valuable and interesting discussions in the grey literature (Edwards, 2012; Nerlich, 2013)) possibly due to their use mostly by outsiders to the academic community. Of these labels, believer appears to be particularly worth addressing however, as it implies religious connotations that are in direct conflict with the notion of conclusions based on scientific evidence (with a related identifier being the "church of global warming"). It is thus used to criticise individuals who do not evaluate knowledge claims on merit, but "believe" that such claims must be true, for a variety of reasons such as uncritical acceptance of scientific proclamations, or because they align with self-interested viewpoints such as the need for supra-national government structures (Jeffrey, 2011).

3.2.2   The mainstream

As has been emphasised throughout this paper, labels in the climate debate focus on identifying those at polarised extremes (whether or not the individuals being labelled as such see their position in this light). Thus an omission that was striking during the course of this research was the lack of label(s) to identify all those who occupy the so-called middle ground between these extremes (with the noted exception of the triptych of 'cautious', 'disengaged' and 'doubtful' from Maibach et al. (2009)). However, we suggest that while not previously identified as such, the notion of a mainstream may in itself be considered to serve a similar function for this middle ground as do sceptic or alarmist for the extremes. The idea of a mainstream appears to be most frequently used to identify the body of climate science that indicates a relationship between human-induced fossil fuel emissions and global temperature increases (Boussalis and Coan, 2013; Hmielowski et al., 2014), with the corresponding labels mainstream climate scientist or mainstream climate science. It is also strongly related with the work of the IPCC (Freudenburg and Muselli, 2010). The idea of a scientific consensus is more controversial (Montford, 2013), despite efforts to quantify its strength (Cook et al., 2013), but is often also used in the context of this mainstream (Anderegg et al., 2010). The notion of the mainstream is interesting as people label and identify themselves in terms of occupation of ranks and positions to create an ideology of their identity. This in turn invokes expectations, guiding their own and others' behaviours and setting the nature of an individual's engagement with activities and people. Thus a mainstream, particularly a mainstream that is in agreement with a (scientific) consensus, is an important label, as it groups together those who self-identify that they

form part of a majority opinion (similar to Kuhn's (1962) concept of prevailing scientific paradigms).

Notably, the idea of a mainstream appears to be largely, if not entirely, limited to climate *science*, as it is apparent that public opinion regarding climate change is ever-evolving (Clements, 2012; Scruggs and Benegal, 2012) and as such no clear labels have been developed to identify this more amorphous public grouping (thus again helping to exacerbate the perception of the climate debate as one between polarised adversaries). Hoffman (2011b) suggests that the most common public position on climate change can be regarded as "convinced" (using a stylised bell curve to represent deniers at one end and believers at the other); however this label is not in common dialogue. It is unclear whether these middle ground opinions have not been the focus of as much labelling attention as it is considered unnecessary to do so, or whether they are regarded as too heterogeneous to accurately categorise.

The notion of a mainstream is also interesting in that it helps to highlight the important idea that labels are not created or applied equally. Similar to other contexts in which labels are used pejoratively (Gadon and Johnson, 2009) or have become stigmatised over time (Asard, 2009), two distinct modes of labelling appear to be occurring within the climate debate, both producing very different outcomes: self- and other-labelling. For example, "the mainstream" is a classic example of self-labelling, defined in social identity theory as the process by which an individual reflects on themselves as an object, and categorises themselves in relation to the pre-existing social categories within their society to create an identity (Stets and Burke, 2000). While it is arguable that there is an overwhelming majority of climate *scientists* who are in agreement with certain fundamental components of climate science such as the idea that humans have a discernible impact on climate processes (Doran and Zimmerman, 2009; Cook et al., 2013; Santer et al., 2013), the same cannot be said of the general public (Boussalis and Coan, 2013). Thus self-labelling helps to see that the notion of a mainstream is problematic, as it not only fails to adequately specify *who* is captured within that mainstream, but it also immediately frames all those who disagree as an outsider. The alternative, creating categories from the outside, variously known as other-labelling or analysts' categories (Edwards, 1998), is also troublesome. For example, while the label of sceptic can often be self-designated, rarely is the label of denier (Niederer, 2013). Conversely, those designated as alarmists, warmists or believers appear to be entirely labelled as such by those at the other end of the spectrum. By creating categories from

the outside rather than engaging claims-makers to create categories for themselves, labels can thus be used to attack, rather than to explain. Hobson and Niemeyer highlight this issue, arguing that 'there is a difference between voluntarily identifying oneself as a climate sceptic and responding to a survey questionnaire that aims to locate those who might be considered as sceptical in some way but do not self-identify as such' (2012: 401).

3.3 Problematic labelling constructs

While more detailed labels can allow for more precise descriptions, and alternative labels may more quickly identify the viewpoint in question, we suggest that climate labels are mostly problematic as they tend towards division rather than acting as a means of bringing actors closer together. Not only is the positionality of labelling largely ignored within the literature (who is labelling whom and how do these labels contribute to ideas of being "right" and "wrong" about various aspects of climate change?), numerous other problems can be identified.

3.3.1 Undertones

Some labels within the debate appear to have the intent of being pejorative, such as denier or alarmist, with the latter associated with "crying wolf" or exaggerating danger (Bacon, 2013). Indeed, the very idea of labelling someone as an alarm*ist*, rather than as legitimately sounding alarm at the potential implications of climate change, implies a diminished importance to that individual's claim and is thus inherently derogative. The use of labels directly influences the way in which individuals are seen in the eyes of others, rather than attempting to understand how, *inter alia*, political or ideological viewpoints contribute to individual opinion formation. For example, in a more overtly political setting, members of the United Kingdom's (UK) Independence Party have been allegedly labelled as "mad, swivel-eyed loons" by members of the UK Conservative Party (Dominiczak, 2013), closely echoing the label of "eco-loons" recently ascribed to "warmists" by some UK climate sceptics (Delingpole, 2012). These derogative labels immediately frame the nature of the debate as antagonistic and combative (as also seen in Kerr and Moy's (2002) examination of newspaper coverage of fundamentalist Christians). Even the greater detail proposed by authors such as Weintrobe (2013) in their sub-categorisations of denial, while positive in aiming to actively highlight

difference within an overall category, fails to avoid the negative implications of the term denier, particularly when it is used as a means of attack.

Labels can also serve to mask the detail of particular points of view, such as the motivations behind why these opinions are formed in the first place, and, as a result, allow for a pejorative overlay to be implied without adequate critical thought. This is particularly concerning given that the meaning of particular labels may change over time. Consequently, what may once have been a term with a positive or neutral implication (such as the idea of scepticism within scientific practice) changes as it becomes associated with particular individuals who hold an outlier view. For example, uncertainty regarding the potential impacts of climate change, as well as our understanding of the global climate system, is a particularly important motivating factor for sceptical opinions (Corner et al., 2012) yet is completely masked by labels such as denier. Importantly, uncertainty is often not due to a lack of scientific understanding, but a 'lack of coherence among competing scientific understandings amplified by the various political, cultural, and institutional contexts within which science is carried out' (Sarewitz, 2004: 385). Moreover, uncertainty, and specifically the words we use to describe uncertainty, means different things to different people (Morgan and Mellon, 2011). Corner et al. (2012) explain that in the field of scientific enquiry in particular, the term has come to be associated with ignorance, and if the perception exists among the general public or the media that scientists do not have 100% certainty, then they do not or cannot know anything (certainly) about it at all. Uncertainties can be deliberately highlighted by those seeking to cast doubt on an overall field of science due to ideological or other motivation (Luntz, 2002) and can play a central role in further deepening opposition between those who conceive of science as a "search for absolute truth" and those who understand it more as an ongoing debate (Rabinovich and Morton, 2012).

3.3.2   Polarised labels and identity attribution

Existing climate labels serve to represent individuals as polar opposites, failing to represent the myriad of opinions that exist between these extremes. As highlighted above, this is particularly obvious as there are no labels existing to identify those whose viewpoint falls within these opposing poles. This binary format, establishing an inherently dualistic and combative debate, is concerning, as it necessarily pits each group against a far-distant "other" and the strengthening of opposition as a result of

these combative labels is clearly evident (Smith and Leiserowitz, 2012). Binary labels also delay public understanding about climate change by contributing to a 'logic schism' (Hoffman, 2011b: 9) across which dialogue is becoming less and less politically viable (Pielke, 2007). Labelling in this context is thus fostering an environment where preservation of one's ideology, identity and the group one belongs to takes priority over constructive deliberation of knowledge or evidence: who one *is* becomes more important that *what* one is arguing. Indeed, assigning directly conflicting labels to groups of individuals based on their opinions risks putting people on 'separate sides of a divide where the purpose of the exercise is to prove each other wrong' (Sciencewise-ERC, 2011). For example, Jones argues that 'pitting liberals against conservatives leads to a polarized perception of the climate change issue and provides little practical guidance for policy makers who may be seeking compromise solutions' (2011: 720).

Thus, the creation and application of labels with an associated set of distinctive characteristics may lead to individuals adopting character aspects, or more and more extreme positions on a particular topic, in order to maintain group identity and homogeneity. This could further stimulate the adoption of the group perspective when processing information as well as the notion of "assimilation bias" whereby an individual habitually selects information which encourages and defends their existing position and ignores data which conflicts with their ideology (Cormick, 2011; Whitmarsh, 2011). To this end, the very act of categorising even by academic social scientists may further emphasise in-group cohesion, exacerbating the existing problem.

Preserving group identity and membership is also argued to be preferable to the potential for cognitive dissonance (Cooper and Stone, 2000) which is understood as a 'negative…state which occurs whenever an individual simultaneously holds two cognitions (ideas, beliefs, opinions) which are psychologically inconsistent' (Aronson, 1969: 2) and which threatens a person's positive self-image. Group membership (enhanced through labelling practices) can reduce dissonance by diffusing individual responsibility for potential negative consequences created by that group, and thus reducing the overall magnitude of the dissonance experienced by any one individual. Eliminating cognitive dissonance can occur by admitting the original opinion was built on false values or evidence, or re-aligning values and beliefs to fit well with the newly formed opinion—however, the latter rarely occurs (Weber, 2013). What is more likely, as Tavris and Aronson (2007) explain using a pyramid analogy, is that, when faced with an issue, individuals will take small steps down one side of the pyramid, each

moving further away from their starting point as a result of their differing interpretations of evidence and associated self-justifications. The consequence is that finally each individual arrives at opposing ends of the pyramid and is unable to recognise the initial similarities between their viewpoints, and see the other's opinions as unreasonable, or even dangerous. Tavris and Aronson suggest that while it is easy to take steps down the side of the pyramid, it is much more difficult to climb back up. The relationship between labels, opinions and group membership therefore suggests that the labels associated with each of these extreme positions in the climate debate may also be an important contributory factor in the challenge of ascending the pyramid in order to engage in productive dialogue.

3.3.3   Fixed opinions

The very act of creating and applying labels can also contribute to an opinion becoming increasingly static, or unresponsive to new information. Individuals piece together different pieces of information from trusted sources to fit with more general values and beliefs and 'do not adopt a rational choice model in which they weigh benefits against costs, utilizing subjective probabilities and discounting the future' (Marquart-Pyatt et al., 2011: 39). Moreover, due to the evolving nature of these attributes, in addition to contextual influences such as the media, it is important to recognise that opinions are not fixed and instead continuously evolve (Zhao, 2009). This point of flexibility is important, as opinions may change based on exposure to new information or changes in external circumstance (Hobson and Niemeyer, 2012; Lewandowsky et al., 2013b). However existing climate labels serve to reduce the need to delve deeper into the exact arguments or motivations made by individual claims-makers and to write off those expressing an opposing point of view by virtue of the category to which they have been ascribed. In other words, the very act of labelling fixes categories, increasing the possibility of transforming into stereotypes. Such labels thus fail to accurately reflect reality, yet cement our interactions with those we have stereotyped (Stets and Burke, 2000). As Koteyko et al. (2012: 9) suggest, stereotypes are a shorthand way in which the "negative other" is conceived in the climate debate, such as 'AGW [anthropogenic global warming] nuts' or 'scaremongering scientists'.

With this in mind, categorisation that leads to stereotyping may in turn reinforce the power of group-identity dynamics. Therefore, not because of personal disagreement but due to the category an individual feels he or she belongs to (or should belong to),

scepticism or disengagement may seem like an appropriate response. For example, McCright and Dunlap (2011b) show that political orientation is a significant factor in opinion formation about climate change in the USA. Social group association, identification and commitment all have implications for the processing of climate change information, the construction of knowledge and concern about the environment, as well as the construction of ignorance and ambivalence (Oreskes and Conway, 2008). It is thus unsurprising that climate change opinions have been demonstrated to be intrinsically linked to an individual's world view, values and beliefs (Whitmarsh, 2011).

3.3.4 Failure at capturing complexity

Labels within the climate debate have also failed to fully capture the complexity of particular opinions about climate change, let alone how they may change over time. Despite the increasingly detailed taxonomies created within the literature, they do not seem to capture well the arguments *and* motivations which together make up an opinion. As Fischhoff (2007: 7205) argues, the choices people make reflect their experience, concerns, behaviours, attitudes and values; however, at the same time, 'it is impossible to judge people fairly or to provide them with needed information without knowing what is on their minds when they formulate, resolve, implement, and revise climate-related choices'. Current climate labels, which actively mask awareness of internal motivation and focus on expressed opinion, are thus acutely problematic.

Labels are also failing to capture geographic complexity, as viewpoints on climate change encompass different meanings in different geographical contexts. Painter (2011), in a study of the occurrence of climate scepticism in the media in China, Brazil, France, India, the UK and the USA identifies the challenges and limitations of our current labels for different opinions about climate change opinions, noting that there can often be a vast difference between different terms, yet sometimes little consideration given to how they are employed. In a recent study of audience segmentation as a means by which targeted climate change messaging can be developed and deployed, Hine et al. (2014) also note that while labels may, 'at least in broad terms' reflect climate change mind-sets, it 'can be challenging to generate labels that are intuitively meaningful, and also faithfully represent the complex combination of variable scores upon which the segments are formed'.

Collapsing important distinctions of arguments or motivations into blanket labels such as sceptic also does little to illuminate arguments and instead, can demonise individual claims-makers. This is not unique to the climate debate. As Cole and Morgan (2011) argue in their examination of derogatory discourses of veganism, labels can serve to misrepresent the experience of what it means to hold a particular viewpoint, and thus marginalise those to whom the label is applied. They suggest that this also harms those who do not share that specific viewpoint, as they are not presented with the opportunity to understand the phenomenon. This also reduces the likelihood of debates being engendered about our fundamental relationship with, in Cole and Morgan's case, nonhuman animals, and in the case of climate change, the environment. The example of veganism has direct parallels with climate change, as, for example, by labelling individuals as alarmists, the general public may be less inclined to want to understand the reasons why such concern is being felt in the first place—with the label serving to "write-off" the need to examine the argument in question. Indeed, as Boykoff (2013: 9) argues, 'treatment of individuals through denigrating monikers does little to illuminate the contours of their arguments; it actually has the opposite obfuscating effect in the public sphere'.

Furthermore, as it remains the simplest and most well-known typology, Rahmstorf's (2005) categories continue to be loosely employed when discussing all types of what we in this paper identify as sceptical voices. However these are often supplemented by additional labels and terms which add to the ambiguity and in a sense "mobilisation" of claims-makers, as boundaries are blurred and the periphery of denial becomes distorted with, for example, those who hold more nuanced opinions; those who question the models used to predict future climate change; those who experience cognitive dissonance; and those who do not deny climate change but fail to act mitigatively. Thus creating a labelling taxonomy to adequately represent the nuances inherent within opinions about climate change may best be regarded as an inherently problematic and possibly futile task.

3.4   The importance of context

In addition to these problematic labelling constructs, the application of these climate labels in context appears also to have been significantly under-investigated (as compared to the considerable effort directed towards academic exercises of classification). For example, while a search of *Web of Knowledge* fails to identify a

single use of the label warmist in the academic literature, it is not an uncommon term both online and in media sources. For example, "climate warmist" resulted in 5,840 results via *Google Search* (on 14 August 2014). On 1,070 occasions, the label "warmist" appears five times or more in English language newspapers (sourced from Nexis online) in conjunction with either "climate change", "global warming" or "greenhouse": 47% of these newspapers are Australian and 35% are UK-based (and of these 24% are publications of the Telegraph Media Group). Why this particular label is vastly more common in Australian and UK media than in other Anglo-Saxon countries where climate scepticism has also been found to be prevalent (such as the USA or Canada) (Painter, 2011) is unclear.

It does seem apparent that different contexts give rise to different forms of climate opinions (for example in terms of relationship to political affiliation) and hence labelling constructs. In the USA, Maibach et al. (2009) identify six different 'Americas' in terms of their relationship to climate change: alarmed, concerned, cautious, disengaged, doubtful and dismissive, with the most extreme of the groups strongly related to, respectively, Democratic politics (alarmed) and Republican politics (dismissive). This relationship between party politics and climate opinions is clearly demonstrated in the US literature; however, this appears to be less of an area of interest for, for example, UK-based scholars.

Taxonomies of climate scepticism, while identifying broad locations where debate occurs such as 'internet forums' (Rahmstorf, 2005: 77) or 'the public sphere, particularly the media' (Hobson and Niemeyer, 2012: 397), provide little to no indication as to the origins of the pre-existing labels identified, not to mention where the authors intend the newly specified labels they have created to be employed in the future. While it is entirely possible to create detailed taxonomies or alternative terms within an academic context, it is a potentially entirely futile exercise if such efforts do not go beyond the confines of university enquiry. One may therefore ask what the point would be in greater specificity if it is unable to change the terms upon which debate is held. Questioning who may be using which labels and to what purpose enables a more nuanced understanding to be held regarding questions of, for example, access to scientific debate (Huntingford and Fowler, 2008), influence of corporate lobbying on policy decision-making (Falke, 2011), or the more general legitimation strategies or rhetorical techniques employed by the multiple actors involved (Malone, 2009; Besel, 2011).

Thus, what is most problematic about the lack of attention given to the specifics of context is that the literature has, to date, missed the opportunity to highlight the power inherent in the application of such discursive terms. For example, why may particular terms be deemed acceptable in certain contexts and not others, and what might that mean in terms of framing the climate debate overall? Schäfer (2012) contends that stakeholders communicate strategically in online environments, yet despite suggesting that 'climate 'sceptics' are perceived to be very present online', provides no further insights into how specific labelling choices may be contributing to these strategic processes of communication. While the appropriateness of terminology in different contexts and its performative effects *on* those contexts is hotly debated in other arenas (see arguments regarding race and ethnicity markers in academic journals (Bhopal et al., 2000) and in wider public use such as legislation (Aspinall, 2009), or the use of disability terminology in the mass media (Auslander and Gold, 1999)), little attention appears to have been paid to such issues within the climate change context.

Furthermore, while claims have been put forward as to the most appropriate locations for overall debate about climate change, these are also rarely adequately reflected upon. For example, Doherty (2009) asserts that 'sceptics and deniers...cut themselves off from ongoing scientific discussion but happily share their views in the full glare of the media'. Not only does such a claim fail to adequately recognise the gated nature of peer review and other processes of scientific discussion (Hojat et al., 2003), it contains an implicit value judgement as to the appropriate nature of the location of debate about climate change, and who, defined by which labels, is able to participate in which contexts. Consequently, whilst these labels may be more attuned to a particular context they remain largely an academic construct and their use and value beyond this scholarly environment is questionable.

3.5   Conclusion: Moving beyond labels

Individuals who are identified by labels such as sceptic or alarmist are highly variable, coming from ideologically diverse backgrounds with different motivations and goals (Hobson and Niemeyer, 2012; Boykoff, 2013). While the literature surrounding climate opinions is large and growing, social science research has so far been unable to fully capture the extent and variety of the arguments and, importantly, underlying motivations that comprise these opinions. Despite recognising that categories are a 'fundamental device by which all members of any society constitute their social order'

(Suchman, 1994: 181), we suggest that each attempt to label climate opinions produced thus far has been unable to accurately portray the complexity that exists, resulting in a mixture of labels which are used interchangeably and confusingly in academia, policy, the media and across other networks. Moreover, this paper has demonstrated that climate labels are serving to isolate, exclude, ignore and dismiss claims-makers of all types from constructive dialogue due to the category label to which they have been assigned (Canales, 2000; Jacques, 2012). Their binary and dualistic format (e.g. an alarmist versus a denier) entrenches positions by focuses on differences, creating an unhelpful "us and them" mentality which reduces opportunities for constructive communication and engagement. Stereotyped narratives associated with labels can also serve to dehumanise individuals (Smith, 2012; Cortina, 2013) so that legitimate concerns are unable to be adequately valued or explored.

We suggest that the debate about labels, as well as the academic focus on detailed taxonomies or new terminology, is a distraction that is diverting attention away from what we consider is the most important issue to address, and one that would do most to encourage constructive dialogue across this polarised debate—a focus on the *underlying motivations and rationales* as to why these different opinions about climate change exist. Focusing on the motivations behind different opinions about climate change is important for several reasons, not least allowing for the identification of common ground between previously polarised individuals, thus creating a thread by which dialogue may begin. Bringing motivations to the fore would also allow for a more open and honest (although no less challenging and difficult) debate to be held about the underlying reasons as to why we disagree (Hulme, 2009). Finally, and perhaps most importantly, focusing on motivations enables an ongoing dialogue to occur which is not about coming to a consensus or conclusion, but rather about emphasising the participatory nature of the dialogue itself.

Encouraging difficult conversations about how different inputs, such as scientific evidence, come to be evaluated as a basis for decision-making, is likely to be more productive and effective in reducing polarisation than debates which hide behind labels and prioritise arguments without understanding their underlying rationales. As Wolf and Moser (2011) argue, it may be necessary to accept that no single theory will be able to represent human experience and action in relation to climate change. We hope that this focus may enable deeper and more constructively critical conversations, which are particularly important in terms of both public perceptions of climate change

and policy decision-making. For example, Ding et al. (2011) show that public perceptions of scientific (and policy) disagreement on climate change leads to lower certainty that climate change is occurring and consequently lower support for climate change policies. Labels are an important component in terms of public awareness of climate change as they frame the conversation as contentious, polarised debate, with this perception also heavily influenced by media coverage, and attempts to provide a (now-recognised as problematic) "balanced debate" (Ward, 2008; Leiserowitz et al., 2013b; Anderegg and Goldsmith, 2014) Moreover, scientists' lack of understanding of whether and how to participate in policy dialogue, combined with policy-makers' misperceptions of caveats in scientific processes can also lead to a confused and ineffective science-policy discourse (Petes et al., 2014).

Understandings about climate change will vary according to historical period, geographical location, and social, political or cultural context. These understandings will also be expressed differently according to philosophical framework or academic discipline. New ways of framing and talking about contentious topics, as well as presenting related information, can have a significant impact on the way a debate is understood (Nelson et al., 1997). We acknowledge that some climate labels will always exist given the human propensity towards classification systems and the desire for shorthand monikers to describe complicated topics, but suggest that placing *less emphasis* on labels as a topic of interest may reduce the legitimacy of particularly derogatory labels as accurate signifiers. We call for an advance to be made in this field of research, and for focus to be squarely placed on individual motivations and rationales and a better recognition of their inherent idiosyncrasies and complexities. In so doing, we argue that unhelpful labelling constructs will have less opportunity to shape and further polarise an already antagonistic debate.

3.6 References

Akter S, Bennett J and Ward MB. (2012) Climate change scepticism and public support for mitigation: Evidence from an Australian choice experiment. *Global Environmental Change* 22: 736-745.

Anderegg WRL and Goldsmith GR. (2014) Public interest in climate change over the past decade and the effects of the 'climategate' media event. *Environmental Research Letters* 9: 054005.

Anderegg WRL, Prall JW, Harold J, et al. (2010) Expert credibility in climate change. *Proceedings of the National Academy of Sciences of the United States of America* 107: 12107-12109.

Antonio RJ and Brulle RJ. (2011) The unbearable lightness of politics: Climate change denial and political polarization. *Sociological Quarterly* 52: 195-202.

Aronson E. (1969) The theory of cognitive dissonance: A current perspective. In: Berkowitz L (ed) *Advances in experimental social psychology.* New York and London: Academic Press Inc., 2-34.

Aronson E. (2008) *The social animal,* USA: Worth Publishers.

Asard E. (2009) The stigmatization of the Liberal label in modern American politics. *American Studies in Scandinavia* 41: 23-35.

Aspinall PJ. (2009) 'Mixed race','mixed origins' or what? Generic terminology for the multiple racial/ethnic group population. *Anthropology Today* 25: 3-8.

Auslander GK and Gold N. (1999) Disability terminology in the media: A comparison of newspaper reports in Canada and Israel. *Social Science & Medicine* 48: 1395-1405.

Bacon W. (2013) Sceptical climate part 2: Climate science in Australian newspapers. Sydney: Australian Centre for Independent Journalism.

Besel RD. (2011) Opening the "black box" of climate change science: Actor-network theory and rhetorical practice in scientific controversies. *Southern Communication Journal* 76: 120-136.

Bhopal R, Rankin J and Bennett T. (2000) Editorial role in promoting valid use of concepts and terminology in race and ethnicity research. *Science Editor* 23: 75-80.

Boussalis C and Coan TG. (2013) Signals of doubt: Text-mining climate skepticism. Cambriedge, MA: Harvard Law School. Available at: http://www.kenbenoit.net/pdfs/NDATAD2013/skepticism_bc2013.pdf.

Bowker GC and Star SL. (1999) *Sorting things out: Classification and its consequences,* Cambridge, MA: MIT Press.

Boykoff MT. (2013) Public enemy no. 1? Understanding media representations of outlier views on climate change. *American Behavioral Scientist* 57: 796-817.

Bryce TGK and Day SP. (2013) Scepticism and doubt in science and science education: The complexity of global warming as a socio-scientific issue. *Cultural Studies of Science Education*: 1-34.

Canales MK. (2000) Othering: Toward an understanding of difference. *Advances in Nursing Science* 22: 16-31.

Capstick S and Pidgeon N. (2013) What *is* climate change scepticism? Examination of the concept using a mixed methods study of the UK public. *Global Environmental Change* 24: 389-401.

Clements B. (2012) Exploring public opinion on the issue of climate change in Britain. *British Politics* 7: 183-202.

Cohen S. (2001) *States of denial: Knowing about atrocities and suffering,* Cambridge: Polity Press.

Cole M and Morgan K. (2011) Vegaphobia: Derogatory discourses of veganism and the reproduction of speciesism in UK national newspapers. *British Journal of Sociology* 62: 134-153.

Cook J, Nuccitelli D, Green SA, et al. (2013) Quantifying the consensus on anthropogenic global warming in the scientific literature. *Environmental Research Letters* 8: 024024.

Cooper J and Stone J. (2000) Cognitive dissonance and the social group. In: Hogg DJTMA (ed) *Attitudes, behavior, and social context: The role of norms and group membership.* Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers, 227-244.

Cormick C. (2011) Why clever people believe in silly things. *COSMOS.* Australia: COSMOS Media Ltd. Available at https://cosmosmagazine.com/life-sciences/why-clever-people-believe-silly-things.

Corner A, Whitmarsh L and Xenias D. (2012) Uncertainty, scepticism and attitudes towards climate change: Biased assimilation and attitude polarisation. *Climatic Change* 114: 463-478.

Cortina SC. (2013) Stigmatizing harm reduction through language: A case study into the use of "addict" and opposition to supervised injection sites in Canada. *Journal of Addictions Nursing* 24: 102-107.

Delingpole J. (2012) Why I am so rude to warmists *The Telegraph.* 28 February 2012. London: Telegraph News and Media Ltd.

Ding D, Maibach EW, Zhao X, et al. (2011) Support for climate policy and societal action are linked to perceptions about scientific agreement. *Nature Climate Change* 1: 462-466.

Doherty P. (2009) Copenhagen and beyond: Sceptical thinking. *The Monthly.* Collingwood, Australia: The Monthly.

Dominiczak P. (2013) Jeremy Paxman: I have heard top Tories call activists 'swivel-eyed loons'. *The Telegraph.* 21 May 2013. London: Telegraph Media Group Ltd.

Doran PT and Zimmerman MK. (2009) Examining the scientific consensus on climate change. *EOS* 90: 22-23.

Dutton JE and Jackson SE. (1987) Categorizing strategic issues: Links to organizational action. *The Academy of Management Review* 12: 76-90.

Edwards D. (1998) The relevant thing about her: Social identity categories in use. In: Antaki C and Widdicombe S (eds) *Identities in talk.* London: Sage, 15-33.

Edwards T. (2012) The sceptical compass. *All models are wrong.* Bristol: WordPress. Available at: http://allmodelsarewrong.com/?p=67.

Falke A. (2011) Business lobbying and the prospects for American climate change legislation. *Gaia-Ecological Perspectives for Science and Society* 20: 20-25.

Fischhoff B. (2007) Nonpersuasive communication about matters of greatest urgency: Climate change. *Environmental Science & Technology* 41: 7204-7208.

Freudenburg WR and Muselli V. (2010) Global warming estimates, media expectations, and the asymmetry of scientific challenge. *Global Environmental Change* 20: 483-491.

Gadon O and Johnson C. (2009) The effect of a derogatory professional label: Evaluations of a "shrink". *Journal of Applied Social Psychology* 39: 634-655.

Goffman E. (1974) *Frame analysis: An essay on the organization of the experience,* New York: Harper Colophon.

Greenpeace USA. (2013) *Dealing in doubt: The climate denial machine vs climate science*. Greenpeace. Available at: http://www.greenpeace.org/international/en/publications/reports/dealing-in-doubt/.

Hamilton C. (2010) *Requiem for a species,* London: Earthscan.

Hine DW, Reser JP, Morrison M, et al. (2014) Audience segmentation and climate change communication: Conceptual and methodological considerations. *Wiley Interdisciplinary Reviews: Climate Change* 1: 1-22.

Hmielowski JD, Feldman L, Myers TA, et al. (2014) An attack on science? Media use, trust in scientists, and perceptions of global warming. *Public Understanding of Science* 23: 866-833.

Hobson K and Niemeyer S. (2012) "What sceptics believe": The effects of information and deliberation on climate change scepticism. *Public Understanding of Science* 22: 396-412.

Hoffman A. (2011a) The culture and discourse of climate skepticism. *Strategic Organization* 9: 1-8.

Hoffman A. (2011b) Talking past each other? Cultural framing of skeptical and convinced logics in the climate change debate. *Organization & Environment* 24: 3-33.

Hojat M, Gonnella JS and Caelleigh AS. (2003) Impartial judgment by the "gatekeepers" of science: Fallibility and accountability in the peer review process. *Advances in Health Sciences Education* 8: 75-96.

Holbrook JB and Briggle A. (2013) Knowing and acting: The precautionary and proactionary principles in relation to policy making. *Social Epistemology Review and Reply Collective* 2: 15-37.

Hulme M. (2009) *Why we disagree about climate change: Understanding controversy, inaction and opportunity,* Cambridge: Cambridge University Press.

Huntingford C and Fowler D. (2008) Climate change: Seeking balance in media reports. *Environmental Research Letters* 3: 021001.

Ingold K and Gschwend M. (2013) Science in policy making: Neutral experts or strategic policymakers? *International Conference on Public Policy*. Grenoble, France: Sciences Po Grenoble. Available at: http://www.icpublicpolicy.org/IMG/pdf/panel_19_s1_ingold.pdf.

IPCC. (2011) Summary for policymakers In: Field CB, Barros V, Stocker TF, et al. (eds) *Intergovernmental Panel on Climate Change special report on managing the risks of extreme events and disasters to advance climate change adaptation.* Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

Islam MM, Barnes A and Toma L. (2013) An investigation into climate change scepticism among farmers. *Journal of Environmental Psychology* 34: 137-150.

Jacques PJ. (2009) *Environmental skepticism: Ecology, power and public life,* Farnham: Ashgate Publishing Ltd.

Jacques PJ. (2012) A general theory of climate denial. *Global Environmental Politics* 12: 9-17.

Jeffrey GR. (2011) *The global-warming deception: How a secret elite plans to bankrupt America and steal your freedom*: Doubleday Religious Publishing Group.

Jones MD. (2011) Leading the way to compromise? Cultural theory and climate change opinion. *PS: Political Science and Politics* 44: 720-725.

Kahan DM, Jenkins-Smith H and Braman D. (2011) Cultural cognition of scientific consensus. *Journal of Risk Research* 14: 147-174.

Kalichman SC. (2009) *Denying AIDS: Conspiracy theories, pseudoscience, and human tragedy*, New York: Copernicus.

Kane O. (2013) Science, expertise and environmental controversies. Some reflections about the Canadian case. *Canadian Journal of Media Studies* 11: 1-12.

Kemp J, Milne R and Reay DS. (2010) Sceptics and deniers of climate change not to be confused. *Nature* 464: 673.

Kerr PA and Moy P. (2002) Newspaper coverage of fundamentalist Christians, 1980–2000. *Journalism & Mass Communication Quarterly* 79: 54-72.

Koteyko N, Jaspal R and Nerlich B. (2012) Climate change and 'climategate' in online reader comments: A mixed methods study. *The Geographical Journal* 179: 74-86.

Kuhn T, S. (1962) *The structure of scientific revolutions,* Chicago: University of Chicago Press.

Lahsen M. (2008) Experiences of modernity in the greenhouse: A cultural analysis of a physicist "trio" supporting the backlash against global warming. *Global Environmental Change* 18: 204-219.

Lahsen M. (2013) Anatomy of dissent: A cultural analysis of climate skepticism. *American Behavioral Scientist* 57: 732-753.

Leiserowitz A, Maibach E, Roser-Renouf C, et al. (2013a) *Global warming's six Americas September 2012,* New Haven, CT: Yale University and George Mason University.

Leiserowitz A, Maibach EW, Roser-Renouf C, et al. (2013b) Climategate, public opinion, and the loss of trust. *American Behavioral Scientist* 57: 818-837.

Lewandowsky S, Gignac GE and Oberauer K. (2013a) The role of conspiracist ideation and worldviews in predicting rejection of science. *PLoS ONE* 8: e75637.

Lewandowsky S, Gignac GE and Vaughan S. (2013b) The pivotal role of perceived scientific consensus in acceptance of science. *Nature Climate Change* 3: 399-404.

Lewandowsky S, Oberauer K and Gignac G. (2013c) NASA faked the moon landing - therefore (climate) science is a hoax: An anatomy of the motivated rejection of science. *Psychological Science* 24: 622-633.

Loveys K. (2010) One in three say climate change is exaggerated. *The Daily Mail.* 24 February 2010. London: Associated Newspapers Ltd.

Luntz F. (2002) *The environment: A cleaner, safer, healthier America*. The Luntz Research Companies - Straight Talk. Available at: https://www.motherjones.com/files/LuntzResearch_environment.pdf.

Maibach E, Roser-Renouf C and Leiserowitz A. (2009) *Global warming's six Americas 2009: An audience segmentation analysis,* New Haven, CT: George Mason University and Yale University.

Malone E. (2009) *Debating climate change: Pathways through argument to agreement,* London: Earthscan.

Maltoni C. (1976) Occupational chemical carcinogenesis: New facts, priorities and perspectives. *IARC scientific publications*: 127-149.

Marquart-Pyatt ST, Shwom RL, Dietz T, et al. (2011) Understanding public opinion on climate change: A call for research. *Environment: Science and Policy for Sustainable Development* 53: 38-42.

McCright AM. (2007) Dealing with climate change contrarians. In: Moser SC and Dilling L (eds) *Creating a climate for change: Communicating climate change and facilitating social change.* Cambridge: Cambridge University Press, 200-212.

McCright AM and Dunlap RE. (2000) Challenging global warming as a social problem: An analysis of the conservative movement's counter-claims. *Social Problems* 47: 499-522.

McCright AM and Dunlap RE. (2011) The politicization of climate change and polarization in the American public's views of global warming, 2001–2010. *Sociological Quarterly* 52: 155-194.

Montford A. (2013) Consensus? What consensus? London: The Global Warming Policy Foundation.

Morgan MG and Mellon C. (2011) Certainty, uncertainty, and climate change. *Climatic Change* 108: 707-721.

Nelson TE, Oxley ZM and Clawson RA. (1997) Toward a psychology of framing effects. *Political Behavior* 19: 221-246.

Nerlich B. (2013) Moderation impossible? Climate change, alarmism and rhetorical entrenchment. *Making Science Public.* University of Nottingham. Available at: https://blogs.nottingham.ac.uk/makingsciencepublic/2013/02/27/moderation-impossible-climate-change-alarmism-and-rhetorical-entrenchment/.

Nerlich B. (2014) From greenhouse sceptics to climate contrarians: A short history of climate scepticism in the English language press (unpublished conference presentation). *Changing Climate Change Communication Conference.* Amsterdam.

Niederer S. (2013) 'Global warming is not a crisis!': Studying climate change skepticism on the Web. *European Journal of Media Studies* 3.

Nordhaus WD. (1994) Expert opinion on climatic change. *American Scientist* 82: 45-51.

O'Neill SJ and Boykoff MT. (2010) Climate denier, skeptic, or contrarian? *Proceedings of the National Academy of Sciences of the United States of America* 107.

Oreskes N and Conway EM. (2008) Challenging knowledge: How climate science became a victim of the cold war. *Contingency and Dissent in Science, CPNSS Research Project.* London: London School of Economics and Political Science.

Oxford English Dictionary. (2013) *Oxford English Dictionary.* Oxford: Oxford University Press.

Painter J. (2011) *Poles apart: The international reporting of climate scepticism,* Oxford: University of Oxford.

Parmar B. (2014) From intrapsychic moral awareness to the role of social disruptions, labeling, and actions in the emergence of moral issues. *Organization Studies* 35: 1101-1126.

Petes LE, Howard JF, Helmuth BS, et al. (2014) Science integration into US climate and ocean policy. *Nature Climate Change* 4: 671-677.

Piaget J and Inhelder B. (1973) *Memory and intelligence,* New York: Basic Books.

Pielke J, R.A. (2007) *The honest broker: Making sense of science in policy and politics,* Cambridge: Cambridge University Press.

Poortinga W, Spence A, Whitmarsh L, et al. (2011) Uncertain climate: An investigation into public scepticism about anthropogenic climate change. *Global Environmental Change* 21: 1015-1024.

Rabinovich A and Morton TA. (2012) Unquestioned answers or unanswered questions: Beliefs about science guide responses to uncertainty in climate change risk communication. *Risk Analysis* 32: 992-1002.

Rahmstorf S. (2005) The climate sceptics. In: Re M (ed) *Weather catastrophes and climate change: is there still hope for us?* Munich: Munich Re, 76-83.

Risbey JS. (2008) The new climate discourse: Alarmist or alarming? *Global Environmental Change* 18: 26-37.

Santer BD, Painter JF, Bonfils C, et al. (2013) Human and natural influences on the changing thermal structure of the atmosphere. *Proceedings of the National Academy of Sciences* 110: 17235-17240.

Sarewitz D. (2004) How science makes environmental controversies worse. *Environmental Science & Policy* 7: 385-403.

Schäfer MS. (2012) Online communication on climate change and climate politics: A literature review. *Wiley Interdisciplinary Reviews: Climate Change* 3: 527-543.

Sciencewise-ERC. (2011) *Interview with Professor Chris Rapley.* Available at: http://www.sciencewise-erc.org.uk/cms/interview-with-professor-chris-rapley/.

Scruggs L and Benegal S. (2012) Declining public concern about climate change: Can we blame the great recession? *Global Environmental Change* 22: 505-515.

Sharman A. (2014) Mapping the climate sceptical blogosphere. *Global Environmental Change* 26: 159-170.

Singer J. (2008) *Nature, not human activity, rules the climate: Summary for policymakers of the report of the Nongovernmental Panel on Climate Change.* Chicago, Illinois: The Heartland Institute.

Smith J. (2012) Call time on climate name-calling: Start talking risk politics. *The Open University Platform.* The Open University. Available at: https://citizenjoesmith.wordpress.com/2012/03/03/call-time-on-climate-name-calling-start-talking-risk-politics/.

Smith N and Leiserowitz A. (2012) The rise of global warming skepticism: Exploring affective image associations in the United States over time. *Risk Analysis* 32: 1021-1032.

Stets JE and Burke PJ. (2000) Identity theory and social identity theory. *Social Psychology Quarterly* 63: 224-237.

Suchman L. (1994) Do categories have politics? The language/action perspective reconsidered. *Computer Supported Cooperative Work (CSCW)* 2: 177-190.

Tavris C and Aronson E. (2007) *Mistakes were made (but not by me): Why we justify foolish beliefs, bad decisions, and hurtful acts,* Orlando: Harcourt.

Thornsby N. (2014) Ed Davey's speech to the IPPR on climate change. *Liberal Democrat Voice.*

Turnpenny JR. (2012) Lessons from post-normal science for climate science-sceptic debates. *Wiley Interdisciplinary Reviews: Climate Change* 3: 397-407.

Walt G. (1994) How far does research influence policy? *The European Journal of Public Health* 4: 233-235.

Ward B. (2008) A higher standard than 'balance' in journalism on climate change science. *Climatic Change* 86: 13-17.

Washington H and Cook J. (2011) *Climate change denial: Heads in the sand,* London: Earthscan.

Watts DJ and Dodds PS. (2007) Influentials, networks and public opinion formation. *Journal of Consumer Research* 34: 441-458.

Weber EU. (2013) Psychology: Seeing is believing. *Nature Climate Change* 3: 312-313.

Weintrobe S. (2013) Introduction. In: Weintrobe S (ed) *Engaging with climate change: Psychoanalytic and interdisciplinary perspectives.* London: Routledge, 1-15.

Weiss CH. (1980) Knowledge creep and decision accretion. *Science Communication* 1: 381-404.

Weller AC. (2001) *Editorial peer review: Its strengths and weaknesses,* New Jersey: Information Today, Inc.

Whitmarsh L. (2011) Scepticism and uncertainty about climate change: Dimensions, determinants and change over time. *Global Environmental Change* 21: 690-700.

Wolf J and Moser SC. (2011) Individual understandings, perceptions, and engagement with climate change: Insights from in-depth studies across the world. *Wiley Interdisciplinary Reviews: Climate Change* 2: 547-569.

Zhao X. (2009) Media use and global warming perceptions: A snapshot of the reinforcing spirals. *Communication Research* 36: 698-723.

Chapter 4. Climate stories: Why do climate scientists and sceptical voices participate in the climate debate?

Abstract

Public perceptions of the climate debate predominantly frame the key actors as climate scientists (CSs) versus sceptical voices (SVs); however it is unclear why CSs and SVs choose to participate in this antagonistic and polarised public battle. A narrative interview approach is used to better understand the underlying rationales behind 22 CSs' and SVs' engagement in the climate debate, potential commonalities, as well as each actor's ability to be critically self-reflexive. Several overlapping rationales are identified including a sense of duty to publicly engage, agreement that complete certainty about the complex assemblage of climate change is unattainable, and that political factors are central to the climate debate. We argue that a focus on potential overlaps in perceptions and rationales as well as the ability to be critically self-reflexive may encourage constructive discussion amongst actors previously engaged in purposefully antagonistic exchange on climate change.

Keywords: climate change, debate participation, perceptions, climate scientists, sceptical voices

4.1 Introduction

Within the positivist scientific tradition, scepticism refers to an organised investigation of reality via empirical observation, informed questioning and doubting claims based on anecdotal evidence or belief (Gower, 1997). However, in the context of climate change, scepticism has become increasingly associated with a public perception of a dualistic, antagonistic "climate debate" characterised by intense disagreement regarding the existence of a scientific consensus on the reality of anthropogenic climate change (Hobson and Niemeyer, 2012). Prevalent arguments include disputes regarding the legitimacy of scientific claims made by the Intergovernmental Panel on Climate Change (IPCC), such as the increased level of confidence between the fourth and fifth Assessment Reports that anthropogenic greenhouse gases are the dominant cause of observed global warming since the mid-20th century, as well as arguments more closely

linked to national circumstances such as debates over renewable energy policies in the United Kingdom (UK) (Carter, 2014). Perceptions of polarisation appear justified, as the majority of public-facing debates about climate change frame the debate as a hostile "battle" or "duel" (Hoffman, 2011; McKewon, 2012).

While climate change is a complex and multi-faceted issue with substantial policy ramifications, these public debates also frequently present the key actors as climate scientists (CSs) versus those who explicitly note their objection as stemming, either in full or in part, from disagreement over the legitimacy of scientific knowledge claims. We use the term sceptical voices (SVs) here in an attempt to move away from the problematic labelling constructs evident in the climate debate (Howarth and Sharman, 2015), but following Painter (2011) in recognising the need for a pragmatic descriptor. This public framing of the climate debate as a scientific disagreement between CSs and SVs has been recognised in the literature. Verheggen et al. (2014: 8964) note that contention regarding the existence of scientific consensus about climate change is at the 'center of the public debate' and Pearce et al. (2014) also suggest that debate is predominantly represented in the public as focusing on the veracity of scientific evidence. This differs to academic understandings which encompass both science *and* policy (Martin and Rice, 2014) or, as Rayner (2012: 117) suggests, an awareness that the climate debate includes policy debate 'conducted by means of a surrogate dispute over the quality of the science'. Indeed, rhetorical devices such as the notion of "sound science" are particularly important in framing fundamentally political debates as scientific (McGarity, 2003-2004). Whilst causality between scientific evidence and policy action is complex to establish and is not the focus here, the *perception* of active scientific debate about the anthropogenic nature or severity of climate change is important because climate change is unlikely to appear on policymakers' agendas without public recognition of its legitimacy as a basis for policy action (Pralle, 2009).

Despite recognising therefore that much of what is disputed are not the explicit knowledge claims themselves, but underlying issues such as competing values (Hulme, 2009) or perceptions of societal risk (Kahan et al., 2012), what remains unclear is why do CSs or SVs then participate in an ostensibly scientifically-focused public debate. Rooted in Converse's (1964) notion of issue publics where individuals are interested in issues of perceived personal relevance, a vast literature exists to investigate motivations behind public participation in political debates. Attention has increasingly been directed towards participation in specific topic areas, particularly those

combining science and controversial policy implications. Ho et al. (2011) find that perceptions of media bias are directly and positively associated with issue-specific participation and Becker et al. (2010) find that ideological predispositions and attention to particular media are also significant. In the case of climate change, opinion leaders play an important role as 'connective communication tissue' (Nisbet, 2011: 357) within issue publics, helping to recruit previously passive members to become further involved. Individuals move up Milbrath's (1965) hierarchy of political participation, from "spectator" to "gladiator"-type activities (such as appearing in political forums) in order to influence others' opinions. However, this literature focuses predominantly on political participation by the general public and is thus inadequate to explain why actors presented as key participants in contentious public debates (in this case, CSs and SVs) either actively choose to, or are drawn into participating in, public scientific controversies. These actors are differentiated from the general public in terms of their status as holders of relevant expertise (Stehr and Grundmann, 2011). This expert status is fundamental, as those who are deemed "experts" are, within an evidence-based policy model, regarded to have a greater degree of influence and power over subsequent policy decisions (Weible, 2008). Critically, expert status may be self-designated by individuals within alternative issue publics and achieved via public profile, or may also be externally-designated via third-party accreditation (such as formal qualifications gained within academic epistemic communities). However we do not aim here to comment on the legitimacy of actors' participation in the climate debate. Whereas attention has previously been directed towards individual understanding of and personal engagement with climate change as an issue (Wolf and Moser, 2011), we do however identify a gap in terms of understanding the underlying motivations behind more active and vocal participation by both types of expert knowledge holders within public scientific controversies.

It is possible that fundamental and impenetrable differences exist between CSs and SVs, with each actor group entering and operating within the climate debate according to distinct paradigms (Kuhn, 1962). For example, scientists are understood to be particularly anxious about retaining control over knowledge claims (Poliakoff and Webb, 2007), with Young and Matthews finding that scientists become especially concerned when they perceive the public as changing the 'meanings of claims based on non-scientific values and principles' (2007: 141). This reflects a desire to uphold the pre-eminence of the positivist scientific tradition as a basis for evidence-based decision-making (Wesselink et al., 2014) as well as (perhaps unconscious) boundary-

making activity (Gieryn, 1999). Alternatively, these differences may not be innate, but it is the public perception of a polarised, scientifically-focused debate that frames these actors as fundamentally different. In this interpretation, framing participants as duelling adversaries in the media (Zhao et al., 2014) or via labelling practices (Howarth and Sharman, 2015), helps to co-construct polarisation over time, ignoring potentially important underlying similarities between actor groups such as overlaps in motivations for debate participation. Ravetz's (2011; 2012) work on 'Climategate' using the framework of post-normal science gives plausibility to the latter scenario as he finds that challenges to the speaking 'truth to power' model of the science-policy interface makes both CSs and SVs uneasy. However, with the turbulent nature and unpredictability of modern life, combined with complexities inherent to different cultures, existing commonalities can be challenging to recognise (Jasanoff, 2004). We are therefore particularly interested in the possibility of identifying commonalities between divergent groups engaged in conflict in order to assess where overlapping motivations for debate participation could facilitate constructive dialogue. Exposure to others' opinions is a known driver of public and individual opinion formation (Moussaid et al., 2013), and critically, explicit recognition of opinion overlaps has been shown to increase positive attitudes across both groups engaged in dispute (Dovidio et al., 2012). Leveraging overlapping opinions, such as consensus regarding particular scientific claims, can reduce climate policy conflict (O'Sullivan and Emmelhainz, 2014) and exposure to ideologically dissimilar viewpoints has also been found to reduce public dissemination of extreme opinions (Wojcieszak and Rojas, 2011).

An example of this occurred in 2014, when 12 CSs and SVs, all active on social media, met in the UK in an effort to 'calm the debate' (Yeo, 2014). While the specifics of the conversation are unavailable, the event was regarded by one of its participants as useful in terms of stimulating discussion and providing the possibility to 'understand each other better' (Watts, 2014). Such occasions indicate the possibility of more nuanced understanding of the different rationales contributing to others' opinions. Importantly, it suggests that focusing on commonalities or engendering deliberative fora to avoid the more common dead-end 'dialogues of the deaf' (van Eeten, 1999: 185) evident in public scientific controversies may be necessary in order to inspire critical self-reflexivity to occur. Self-reflexivity is a crucial process as it, in essence, requires individuals to question their own inherent assumptions and values (Cunliffe, 2004), and is may reduce antagonism and hostility between actors involved in polarised and adversarial public debates. Moreover, examining *together* the underlying rationales

behind issue publics and more formal epistemic community participation in public scientific controversies is important because it may suggest avenues for constructive dialogue, rather than dualistic debate. This is a critical methodological distinction because it innately reduces the dichotomy of the lay public versus an accredited knowledge holder(s).

4.2 Method

A series of 22 semi-structured interviews were conducted with UK-based individuals identified as CSs (n=11) and SVs (n=11) (Table 4.1). As much of the literature on the climate debate is US-focused, this research provides an important alternative perspective. In order to delve beyond explicit statements of self-declared rationales towards more latent motivations, interviews aimed to enable participants to build their own narratives and to critically self-reflect on them throughout the interview. While research interviews engender an artificial situation (Hollway and Jefferson, 2000) where interviewees may feel the need to provide answers they think the interviewer wants to hear (Schwarz, 1999), stories told within an interview can also form part of an important 'meaning-making process' (Seidman, 2013: 7), interpreted by the researcher using theoretical underpinnings to form relevant conclusions. Daniels and Endfield (2009) suggest that the method in which people receive and interpret climate change information, particularly of its "dangerous" nature, affects resulting actions. Thus, by producing their own stories, interviewees offer a window into personal experiences and a mechanism by which to self-reflect (Hards, 2012). Hiller and Diluzio (2004) also suggest that interviewees participating in narrative-based interviews carry out a complex discursive activity known as reflexive progression. Through this process the interviewer can 'push further for linkages, motivations and clarifications that lead to new discoveries by the interviewee... [and create] some kind of order that was previously unclear, even to the interviewee' (Hiller and Diluzio, 2004: 17).

Questions covered three main themes: (i) how each actor perceives themselves, (ii) perception of a dominant "other" (most commonly framed as a polarised adversary), and (iii) the perceived usefulness of participating in a vocal and public debate, including perceptions of debate framing. The first two themes were chosen in order to understand whether actors' perceptions of themselves or the "other" could be seen as contributory factors towards debate participation. The third theme covered a wider range of topics relevant to debate participation such as perceptions of debate topic

(both explicit and latent), labelling practices, and why they as individual actors should be involved. Interview transcripts were analysed using a mixture of descriptive and thematic coding (Thomas, 2006). Whilst verbally narrating their thought process, interviewees were also asked to place their opinion, and that of a dominant "other" (representing the main arguments encountered that oppose their point of view) on a spectrum of opinion with two axes (science and policy), building on Capstick and Pidgeon's (2013) epistemic and response scepticism.

Table 4.1: Interview sources

Category	Source	Number of interviewees
Climate scientists (CSs)	Senior, most >30 years post-PhD	6
	Mid-career, most 15-30 years post-PhD	2
	Early-career, most <15 years post-PhD	3
Sceptical voices (SVs)	Individuals from the 'list of sceptics 'mentioned' more than once in 10 UK national newspapers' (Painter, 2011)	4
	UK-based blog authors from Sharman (Sharman, 2014)	4
	Involved with the activities of the GWPF e.g. Academic Advisory Council or published on GWPF website	3
		22

Participating CSs' specialisms included climate modelling and climate physics, with all participating in public engagement activities such as public speaking or blogging. CSs were selected using Kahan's (2013) list of characteristics defining a credible scientist, including professional experience in the climate science field (e.g. contributors to IPCC Assessment Reports), number of peer-reviewed publications, and seniority. SVs were identified from three sources: Painter's (2011: 128) 'list of sceptics 'mentioned' more than once in 10 UK national newspapers'; Sharman's (2014) climate sceptical blog authors, chosen due to online sources' increasing importance in the climate debate (Gavin and Marshall, 2011); and those associated with the Global Warming Policy Foundation (GWPF), a well-known sceptical voice about climate change in the UK.

4.3   Perceptions of self

The dominant theme driving climate scientists' (CSs) self-perceptions was a youth-driven aspiration to contribute positively to the environment. Personal experiences of nature during childhood were critical, with many CSs recalling that they "*enjoyed being outdoors*" (CS5) or being in close proximity to "*the natural world which surrounded*

our houses" (CS1). Other experiences built on this engagement with nature, such as CS10 recalling hearing a talk at primary school that led to him "*becoming worried about the environment*" as a result, or from family influences, such as CS1 who remarked that "*I've always had an interest in energy, right from being a child. My dad worked at a nuclear power station and we lived around the corner from it*". These early experiences were identified as important contributory factors to the subsequent aspiration to take a career path that was regarded as "*positive or useful*" (CS2) to society. Two other directly-related sub-themes were identified: an ongoing fascination with the environment, and a heroic desire to do good. CSs mentioned a sustained curiosity driven by frequent occurrences of professional amazement or awe inspiring their interest in the natural sciences. While this fascination for some was directly youth-driven, for others it emerged after a few years in the field, as the original choice to work in climate change arose from the need to be employed. CS4 identified that "*I probably stumbled into the area… [as after] finishing my PhD I needed a job*" and CS8 noted that at the start, "*I didn't believe that this was going to be my life-long career*". However, nearly all perceive themselves as having a heroic desire to "*do something that felt more tangibly useful to society*" (CS10) or to "*[work] on a problem that was an important problem for society*" (CS2). In making these statements and creating their personal narratives, the CSs emphasise the value of their work to society as well as how it fits in the growing international context of climate change as a topic of public concern. They are also cognisant of the obligations placed on them as recipients of public funds, particularly as regards requirements to publish results truthfully, despite the possibility they may be *"politically unpalatable"* (CS9). The spectrum presented to interviewees enabled actors to further self-reflect on their opinions with most CSs placing themselves in the top right quadrant (Figure 4.1). This was predominantly based on high value being accorded to scientific knowledge claims that climate change was having serious global impact. Reflections on the certainty of this evidence were however noted, with CS6 commenting that "*nothing is certain, but it's very certain*" and CS9 narrating:

> *If you're defining anthropogenic climate change as global mean surface temperature, then I'll be right up high at the top here in terms of certain. If you're talking about anthropogenic climate change in particular regions of the globe, at particular times of the year around the place, I would be far less than certain. I have a range, depending on what your definition is.*

Indeed, two interviewees (one CS, one SV) were critical of the notion of "certain" evidence for anthropogenic climate change and chose not to place themselves on the spectrum at all.

The dominant theme underlying sceptical voices' (SVs) self-perceptions was that of being a crusader for truth. The actor disinterestedly and independently investigates scientific claims made about climate change and finds them either incorrect or, more commonly, corrupt and self-serving. There was a strong moral rationale underpinning this theme. SV3 noted that "*I have to give up a job and have no earnings in order to have someone…who can stand up and say it's not about politics; it's about whether the evidence is right!*". The SV is thus fighting to expose climate change as the "*biggest scandal in modern science*" (SV5). The ideal of disinterested investigation based on evidence, unrelated to "*motivation like a thick brown envelope from the oil industry*" (SV9) is critical to this self-perception, even when the actor acknowledges that their view on climate policies influences their view on climate science. Seven SVs disagreed that personal values influenced their opinion as they felt it was more inconvenient to take a contrary point of view to that espoused by the majority. However others were more critically self-reflective during the interview process. For example, SV6 recognised a greater personal interest in sources which suggested climate change was not a serious problem. SV8 explicitly identified the role of individual values as being an important part of opinion formation, specifically as regards "*understanding how people perceive problems and risks*". Two sub-themes support the crusader self-perception: opposition to the hype of climate science and concern for equity. The first involves the actor being triggered by a single event (e.g. Climategate) or gradually over time, to investigate scientific claims (and associated economic implications) and finding them "*over-egged… exaggerated…not realistic*" (SV8). This exaggeration is done by scientists, the media or others, all of whom have a financial stake in maintaining the mainstream consensus. Equity captures the opinion that current climate change policy is "*hurting… the poor*" (SV1) both in the UK and internationally. Thus the SV perceives him/herself as standing up and fighting for a society which "*should be richer… more abundant, [and where] more people should have access to more energy*" (SV7).

The vast majority of SVs disagreed with government GHG emissions-reduction policies, near-exclusively on a cost basis. There was a clear message that climate change policy would "*bust the economy*" (SV11) and, building on the crusader and equity themes, that the ensuing ramifications would be felt most acutely by the poorest members of

society. However, opinion as regards the certainty of scientific evidence for anthropogenic climate change was divergent. As with climate scientists, most SVs found it challenging to place themselves on the spectrum (Figure 4.1) because "*certain is a bad word in science*" (SV2). The spectrum also highlighted difficulties SVs felt of articulating necessary assumptions and caveats around specific knowledge claims into the debate. Many SVs railed against the public perception of the debate as "*black and white, yes/no*" arguing it should be more focused on "how *much and* which *policies*" (SV10, emphasis in the original). This tension between the latent and manifest elements of the public-facing climate debate, particularly in terms of the instrumental use of certain types of knowledge claims, was important. For example, even though SV10 frequently publicly criticises climate science he argued that "*I don't think anyone's interested in climate science per se… No-one cares. Only people care when it comes to policy*".
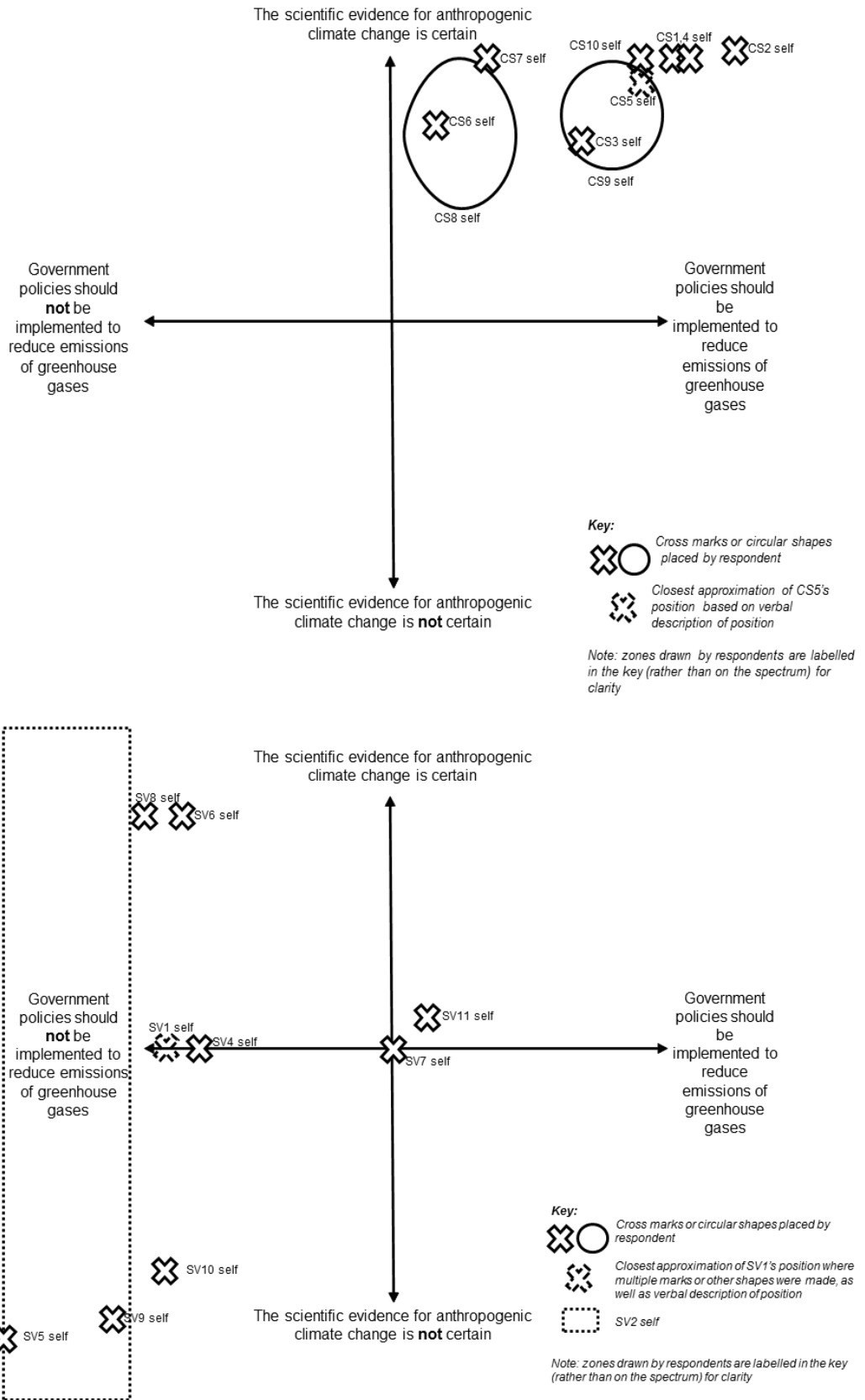
Figure 4.1: Climate scientists' (above) and sceptical voices' (below) opinions

4.4   Perceptions of a dominant "other"

Climate scientists (CSs) found it challenging to identify a single opposing dominant voice, particularly as regards the spectrum in Figure 4.2. However, the most prevalent theme was that opposing opinions arise due to a lack of understanding about climate science itself, and that this misunderstanding results in people feeling threatened and needing to look for "*ways to justify not accepting it*" (CS3). A wide range of opposing arguments were encountered, including those who disputed the certainty of climate change science, through to those who "*don't deny there's some anthropogenic component of climate change*" (CS1) but who were more concerned with economic or social rationales. This perception of a lack of understanding was supported by two sub-themes. First, CSs frequently acknowledged that opposing arguments may be fundamentally driven by perspectives on government intervention in society. These opposing arguments use scientific uncertainty to suggest that "*there's not enough evidence to justify government regulating carbon emissions*" (CS11). CSs were however divided on the extent to which their role should involve engaging in manifestly political debate and making policy recommendations (see Section 4.5). Thus, even though CSs are key actors in public debates that explicitly focus on scientific claims, they frequently recognise that the nature of the debate itself (particularly its potential to be based on disagreement with policy choice) means that they may not always be the right debate participant. Second, most CSs acknowledged that the opinions of others were strongly linked to values, particularly in terms of how climate change challenges existing ways of life. For example CS4 explicitly referred to climate change making people "*uncomfortable*" as it challenges their "*cognitive and normative values*". This suggestion that the opinions of those who challenge mainstream climate science are largely formed by values and not by a rational assessment of evidence is important to note as it implies the possibility of normative judgement regarding the legitimacy of others' opinions. Opposing voices are perceived by CSs as being strongly emotionally influenced and experiencing "*fear, guilt, grief, loss, hopelessness*" (CS3) in response. Discomfort regarding the causes and potential solutions to climate change was mentioned, as was reference to different perceptions of human interaction with nature. For example CS3 noted encountering a "*religious belief that we have dominion over the planet rather than we have its custody and care in our gambit*". Nonetheless, a spectrum of opposing arguments is recognised. As CS6 notes,

> "*[there is a] spectrum of opinions because people have different attitudes and different weightings on how you take now, the future, yourself in the scheme of*

richer people, poorer people, people in different countries, whether you agree in principle with the governments controlling these things or not".

Sceptical voices (SVs) clearly identified a dominant other fuelled by vested interests, standing in direct contrast to their role as a crusader and "*seeker after truth*" (SV2). These vested interests included scientists who are focused on "*trying to save their jobs*" (SV6), although a distrust of the civil service (including but not limited to government scientists) was also present and related to perceptions of an alleged left-wing agenda. Charges that SVs were themselves funded by interests such as fossil fuel companies were strongly refuted. There was also anger at perceptions of politicised science wherein scientists ignore the "*ugly facts*" so that they can make a "*political play*" (SV11). This may also help to explain why CSs are seen as the dominant other as opposed to political actors. For example, SV9 alleges the existence of a "*nexus of media plus politicians plus establishment plus science which is funnelling literally billions and billions and billions of pounds into academic research*" (SV9). This is particularly interesting when contrasted with perceptions of the role of evidence itself in the decision-making process. Whereas there is frustration with "*people who can't understand that if the policy isn't backed up by the evidence you shouldn't be doing the policy, especially if it's... costly*" (SV3), this does not translate into agreement that "*scien*tists *ought to be having more impact on policies*" (SV11, emphasis added). Evidence is perceived as needing to be able to speak for itself because scientists, "*are clearly, clearly not telling the truth*" (SV1). Therefore while most of the SVs entered the climate change debate ostensibly due to disagreements over scientific elements (see the crusader theme above), they do not perceive that the other is similarly-motivated by a search for scientific truth, and is instead corrupted by political or financial incentives. The dominant other is near-unanimously perceived to be certain about the scientific evidence for anthropogenic climate change and supportive of government GHG emissions-reduction policies, reflecting the public perception of a polarised debate (Figure 4.2).
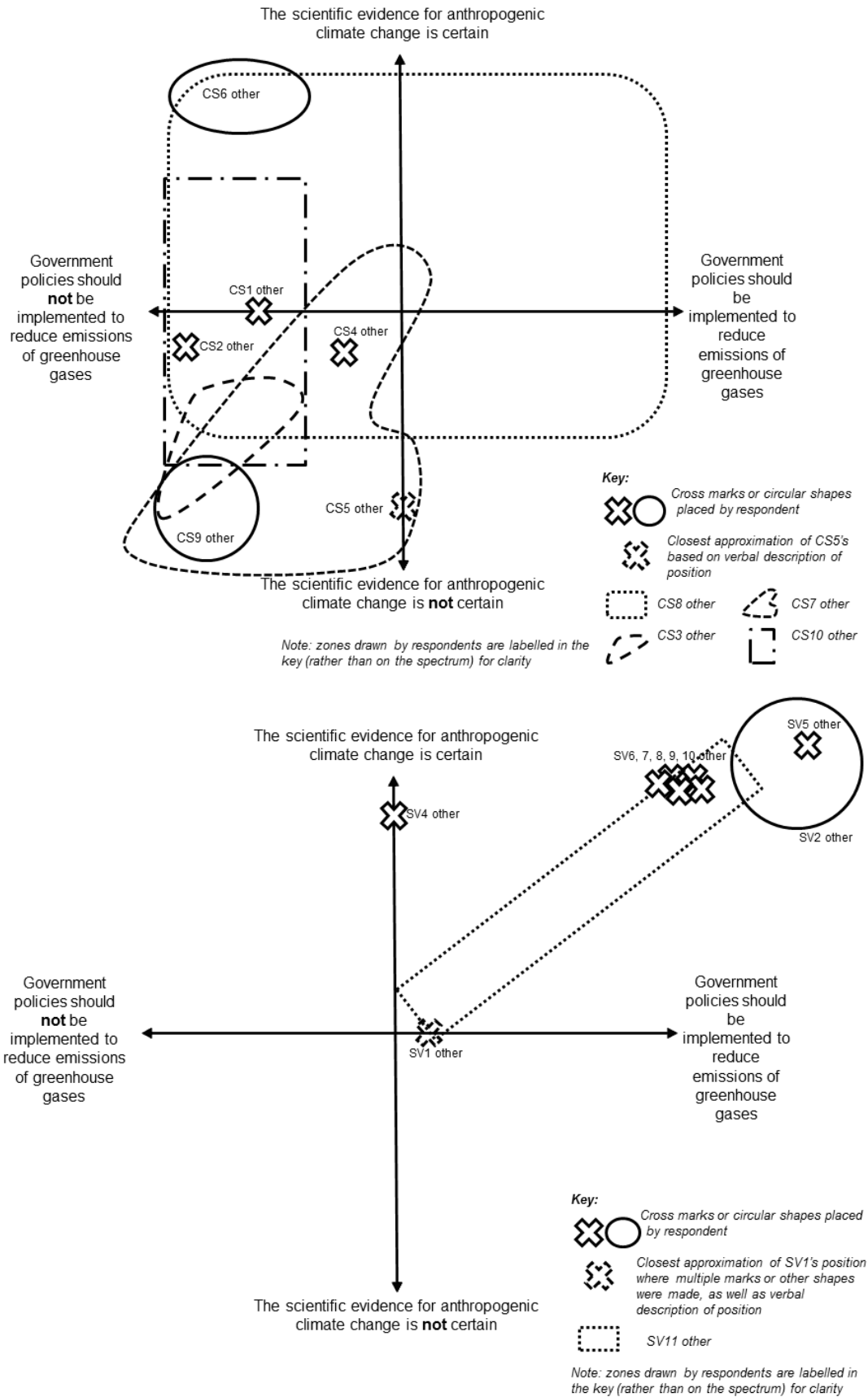
Figure 4.2: Climate scientists' (above) and sceptical voices' (below) perceptions of the dominant others' opinion

4.5   Debate participation and framing

Despite it at times affecting relationships with their peers, the climate scientists (CSs) interviewed see it as essential to be publicly vocal about their work, particularly in terms of explaining the methods and data that have led to their conclusions. Being publicly vocal is regarded as critical as it was seen as easy for the public "*to dismiss us and dehumanise us and make assumptions about our agenda and have reservations if they don't see us out there*" (CS10). This dominant theme of a strong sense of duty to communicate research findings was related to the publicly-funded nature of their work and the significant social implications arising from certain findings. However, many acknowledged that it is "*not second nature*" (CS4) for many CSs to be good public science communicators, as "*the qualities that make you a good scientist, they're not qualities that make you good communicators, they're almost the opposite*" (CS2). Consequently it is seen as understandable that many CSs have historically been reluctant to be publicly vocal. It was also argued that public engagement is not valued by universities and that CSs may be reluctant to publicly engage as they are fearful of their statements being misinterpreted or exaggerated in the media. As a result, CS9 notes that he has been "*deafened by the roar of the silence of scientists*".

Several sub-themes were also identified. CSs have extensive experience of being labelled and attacked, using epithets such as *"corrupt"* (CS3), "*naïve, misguided, a moron*" (CS10) and "*a liar, a cheat, a fraud*" (CS7). CSs strongly believe labels, and indeed their personal experience of being labelled, leave people feeling angry and defensive, as well as deepening "*the polarisation and the entrenchment of views*" (CS10). Several CSs noted that in public discourse they attempt to avoid such labels or find words without negative connotations. Some also identified explicitly trying to directly personally engage with those who hold diametrically opposed opinions, such as via the meeting of CSs and SVs referred to in the introduction above. A general consensus emerged among interviewees that debate participation should be encouraged "*as long as it's constructive*" (CS6). This meant that participants should present "*credible arguments that they can back up with science*" (CS4), as well as bringing to the table "*their concerns, their worries, their opinion and what we should do about it, who should do it*" (CS2). There was also a commonly held perception that the current climate debate is not being held on an equal footing. For example, CS9 commented that he was is "*increasingly perturbed that people make what look to be very cogent and very eloquent conclusions but actually have completely nebulous, unframed starting points*". Therefore whereas the CSs interviewed do engage in public

debate, they are often cautious about this engagement because debates are often seen as inadequately focused on scientific topics or involve other actors who are deemed to be less credible in terms of their expert status. It is thus unsurprising that most CSs believe that their engagement in the climate debate should not be overtly political and that they as scientists should remain "*impartial and humble and open to criticism*" (CS10). The need for establishing a frame of credibility and expertise came across strongly from the CSs who believe those who participate in the debate must be accredited and where the authoritarians of climate science consist of "*people who have got first or second degrees in relevant disciplines and have spent a certain amount of professional investment of their life and study and publishing*" (CS8). CSs expressed frustration that the climate debate involves actors who mix science and policy issues when engaging with scientists thereby using the arguments interchangeably to suit their purpose: they are "*resistant against the science when really they're resistant about policy*" (CS10) and where "*they're still propagating that policy scepticism back to the science*" (CS10). There was however a certain tension between this desire to retain a separation between science and policy, with CS11 commenting that the nature of the issue means that "*some advocacy is warranted*".

The dominant driver for sceptical voices (SVs) participation in the climate debate was "*a sense of duty*" (SV3) to bring an important alternative perspective to the table. This was supported by numerous rationales. For example, SV1 identified being driven by a combination of "*a passion for science and…justice and poverty*" as what is happening (current climate policy) is "*wrong and…is hurting people*". SV2 is concerned with exposing "*scientific fraud*"; to the point that he is "*gradually encircling them [climate scientists] and it will eventually be reported to the police*". A clear tension was however identified between frustration with the "*politicised*" (SV8) and "*very unscientific*" (SV11) nature of the climate debate, and a clear and consistent message of disagreement with government climate-related policies. Several SVs emphasised the impact of climate policies on energy prices as a key motivation for debate participation. As SV11 argues, *"energy is the basis of all wealth [so]…all this green economy stuff is rubbish…We're not a post-industrial nation. We can't possibly exist on services*". The relationship between energy policy and immediate political imperatives was frequently mentioned, particularly as regards need to retain security of energy supply and the impact of green levies on energy prices. Bringing this perspective to the debate was seen as imperative to avoid *"damaging both households and industrial competitiveness*" (SV9).Notions of equity as well as opinions regarding the role of

government in society were also present. For example, while SV7 acknowledged that *"there is a problem of climate change...that does require some level of intervention"*, the nature of this intervention was disputed. SV7 argued that "*it doesn't have to be top-down...it should be democratic and we should be left better off*". SV2 also contended that:

"*climate science...is about pursuing a...nasty political agenda, it's a collectivist, centralising, bureaucratic political agenda which will make a few people very rich at the expense of everybody else*".

The tension between the scientific and political framings of the climate debate was also related to the notion of belief or religion, and sometimes with the idea of a scientific consensus. For example, SV11 suggests that the public climate debate is framed as a matter of "*don't argue, the science is certain. Believe!*". The notion of belief stands in contrast to the desired pre-eminence of traditional scientific enquiry where "*the arbiter of all the arguments is empirical evidence*" (SV8). For many SVs, the notion of belief was also strongly linked to the way that labels were seen to frame the debate as antagonistic between duelling sides. SV11 also noted that the use of labels "*more begs religion than it does science. When you have a religious orthodoxy, then people that disagree with it tend to be called deniers and hunted down*". Labelling was regarded as "*very unhelpful*" (SV10) as it is perceived as a mechanism to shut down debate. It was also suggested that the use of labels can further polarise individuals as those using them "*don't realise that members of the public are thinking, well, that's me as well he's talking about*" (SV10) thus "*forcing a dialogue between the middle ground...and the sceptics*" (SV7). Labelling was thus also seen to limit the possibilities for constructive dialogue. SV7 commented that:

"*Everyone walks into the room knowing that there are two sides, and there's no nuance. And so you try and express some kind of perspective. Oh right, so you're not one of us, you're one of them, and it's really powerful*".

No clear signal existed as to the importance of either themselves or others being publicly vocal (despite all being chosen due to their public profile). While half believed that it was "*absolutely*" (SV9) vital to vocally express their opinion, others were more cautious, with SV7 suggesting that it "*depends on the level of the debate*" as to whether or not participation was recommended. SV8 took recourse in the idea that evidence would be the key arbiter, only wanting to be vocal "*in a measured way [as] we're not campaigners...at the end of the day arguments will win*". And whereas SV6 considered

it critical to be active in the debate as "*people have to fight their corners, so yes, the more the merrier*", he also noted that the hostile nature of the debate is both undesirable and off-putting to many. The notion of consensus was clearly seen as an attempt to close down debate, with SV5 passionately arguing "*don't* ever *tell me what I can or cannot have a debate about, don't you ever say that to me! That's fascism!*".

4.6   Discussion and conclusion

This research investigated the underlying rationales behind the participation of climate scientists (CSs) and sceptical voices (SVs) in the climate debate, focusing in particular on potential overlaps between previously polarised individuals as well as each actor's ability to be critically self-reflexive about their own and others' opinions about climate change. Three research themes were investigated using a narrative format: perception of self, perception of a dominant "other", and the perceived usefulness of participating in a vocal and public debate, including perceptions of debate framing. Table 4.2 summarises the dominant themes emerging from both CS and SV narratives. While the sample size of 22 interviewees necessitates caveats regarding the representativeness of these findings and suggests the need for further research with a larger population, a notable degree of overlap between themes expressed by both actor groups is apparent.

Table 4.2: Key themes

	Climate scientists	Sceptical voices
Perception of self	*Dominant theme:* Youth-driven aspiration to contribute positively to the environment *Sub-themes:* → Fascination with the environment → Heroic desire to do good	*Dominant theme:* Crusader for truth *Sub-themes:* → Opposition to the hype of climate science → Concern for equity
Perception of a dominant other	*Dominant theme:* Lack of understanding of climate science *Sub-themes:* → The role of government in society → Values-laden response	*Dominant theme:* Vested interests *Sub-theme:* → Politicisation of scientific process
Debate participation and framing	*Dominant theme:* Sense of duty *Sub-themes:* → Labelling is negative → Accreditation is vital → Credible debate needed → Debate is often actually about policy, not science	*Dominant theme:* Sense of duty *Sub-themes:* → Labelling is negative → Disagreement with government policy, especially energy policy → Climate change as a belief

Immediately apparent is the mutual sense of duty to participate in the climate debate, albeit recognising that CSs and SVs may have differing levels of inclination or access to particular venues for engagement, such as the peer-reviewed literature versus blogosphere discussion. Whereas SVs largely feel marginalised by the mainstream press, the CSs who do have a greater level of access are cautious due to worries of misinterpretation. Nisbet and Markowitz's (2014) finding that scientists' engagement in overtly public activities such as media appearances is a function of political outlook, as well as holding the opinion that media coverage was important for career advancement, is likely applicable in this instance. We build on this finding by adding that a strongly held sense of duty (which may be unrelated to specific political outlook) is also a likely contributory factor for debate participation. Commonality in terms of self-perception regarding the moral rationale to do what was right for society (the CSs' heroic desire to do good and the SVs' crusade for truth) is also apparent. While the analysis carried out by SVs as adults was distinct from the rationales underpinning CSs more youthful motivations, both groups self-identify as moral actors acting upon deeply held convictions. Another interesting overlap identified via the opinion spectrums (Figures 4.1 and 4.2) was the recognition that certainty was a challenging

concept both in terms of precise definition and as a basis for policy decision-making. While there were clearly differences of opinion regarding the level and/or nature of certainty required for policy implementation, possibly due to different "ways of life" as explained by cultural theory (O'Riordan and Jordan, 1999), many CSs and SVs acknowledged that the notion of a general scientific certainty about such a complex assemblage as climate change is unattainable. Recognising that certainty is multi-faceted and that particular knowledge claims may be uncertain or contested without casting doubt on other pieces of evidence has significant implications as it may engender more explicit and necessary discussions about the trade-offs between scientific evidence and political decision-making.

While a common public perception is that of a single debate where climate scientists are representatives of scientific truth and sceptical voices are the dominant challengers, this research contributes to understanding of a more complex reality by also highlighting the potential misalignment of actors and their roles in engaging in public debate. Nearly all SVs expressed an underlying interest in the impact of climate change policies on the economy despite explicit disagreement with the politicisation of the scientific debate. CSs were also acutely aware, and often made uncomfortable by, recognition that much of the debate centred on disagreement about policy choice rather than the science itself. If the actor-subject interaction in public discourse were to be renegotiated (i.e. politicians debating policies rather than CSs, or CSs actively choosing to debate the policy implications of their research), it may reduce the exhaustive nature of the debate where dead-end arguments are being held precisely *because* they do not make explicit what is actually being debated, i.e. Rayner's (2012) surrogate debate. The suggestion of critical self-reflexivity evident in some interviews, such as SV6 and SV8 who presented themselves as able to (at least explicitly) acknowledge that personal values shaped their opinion, was also interesting. It was however not evident in the majority of interviews. We contend that critical self-reflexivity is likely to be particularly useful in debate re-framing as it helps to pare back the actual topic of disagreement (Hulme, 2009) and forces the centre of the debate to shift towards a more overtly policy or values-focused dialogue. This is particularly important for public perceptions of climate change and how debate is understood to be a useful and necessary part of the scientific process.

Nonetheless, despite uncertainty regarding the extent to which self-reflexivity did or can occur, what we consider the more important outcome of the narrative method

employed for this research is its ability to uncover overlap in interviewees' perceptions and rationales. What is particularly significant is that even the way that each "side" of this polarised debate *chose* to express themselves can invite the possibility for constructive dialogue. Critically, identifying and emphasising these commonalities can be seen as a possible mechanism to defuse the antagonism evident in the debate. For example, it may be difficult to continue a hostile argument when participants are reminded of commonalities such as a mutual love of enquiry and scientific understanding, or agreement regarding the antagonistic and potentially off-putting nature of the current climate debate. This research also indicates that whereas inevitable differences of worldview exist, such as regarding the role of government in society (explicitly identified as a topic of concern by SVs and rarely mentioned by CSs) or which types and holders of knowledge are valued in public debate (with accreditation more highly valued by CSs than SVs), greater commonalities also exist than may be acknowledged in public forums. Building on cultural interpretations of the many different understandings of climate change (O'Riordan and Jordan, 1999; Hulme, 2014), we therefore suggest that a focus on potential overlaps between underlying (and/or manifestly expressed) rationales behind climate opinions may encourage constructive discussion even with actors who had previously engaged in purposefully antagonistic exchange. Identifying even one or two such commonalities in motivations and opinions could provide a valuable source for collaborative and constructive dialogue whereby those involved utilise these commonalities to facilitate a further exchange of ideas. Based on the common themes identified above, and in order for this to progress in practice, we suggest that it is critical that the purpose or frame of the debate is made as explicit as possible (i.e. whether scientific or political factors are the focus of contestation) so that participating parties may be nominated appropriately.

4.7 References

Becker AB, Dalrymple KE, Brossard D, et al. (2010) Getting citizens involved: How controversial policy debates stimulate issue participation during a political campaign. *International Journal of Public Opinion Research* 22: 181-203.

Capstick S and Pidgeon N. (2013) What *is* climate change scepticism? Examination of the concept using a mixed methods study of the UK public. *Global Environmental Change* 24: 389-401.

Carter N. (2014) The politics of climate change in the UK. *Wiley Interdisciplinary Reviews: Climate Change* 5: 423-433.

Converse PE. (1964) The nature of belief systems in mass publics. In: Apter D (ed) *Ideology and discontent.* New York: Free Press, 206-261.

Cunliffe AL. (2004) On becoming a critically reflexive practitioner. *Journal of Management Education* 28: 407-426.

Daniels S and Endfield GH. (2009) Narratives of climate change: Introduction. *Journal of Historical Geography* 35: 215-222.

Dovidio JF, Saguy T, West TV, et al. (2012) Divergent intergroup perspectives. In: Tropp L (ed) *The Oxford handbook of intergroup conflict.* New York: OUP USA, 158-178.

Gavin N and Marshall T. (2011) Mediated climate change in Britain: Scepticism on the web and on television around Copenhagen. *Global Environmental Change* 21: 1035-1044.

Gieryn TF. (1999) *Cultural boundaries of science: Credibility on the line,* Chicago: University of Chicago Press.

Gower B. (1997) *Scientific method: an historical and philosophical introduction,* London: Routledge.

Hards S. (2012) Tales of transformation: The potential of a narrative approach to pro-environmental practices. *Geoforum* 43: 760-771.

Hiller HH and Diluzio L. (2004) The interviewee and the research interview: Analysing a neglected dimension in research. *Canadian Review of Sociology* 41: 1-26.

Ho SS, Binder AR, Becker AB, et al. (2011) The role of perceptions of media bias in general and issue-specific political participation. *Mass Communication and Society* 14: 343-374.

Hobson K and Niemeyer S. (2012) "What sceptics believe": The effects of information and deliberation on climate change scepticism. *Public Understanding of Science* 22: 396-412.

Hoffman A. (2011) Talking past each other? Cultural framing of skeptical and convinced logics in the climate change debate. *Organization & Environment* 24: 3-33.

Hollway W and Jefferson T. (2000) *Doing qualitative research differently: Free association, narrative and the interview method,* London: Sage.

Howarth C and Sharman A. (2015) Labeling opinions in the climate debate: A critical review. *Wiley Interdisciplinary Reviews: Climate Change* 6: 239-254.

Hulme M. (2009) *Why we disagree about climate change: Understanding controversy, inaction and opportunity,* Cambridge: Cambridge University Press.

Hulme M. (2014) Climate change: One, or many? *Presidential Session: 'Geographies of Climate Change' at AAG Annual Conference.* Tampa, Florida.

Jasanoff S. (2004) Ordering knowledge, ordering society. In: Jasanoff S (ed) *States of knowledge: The co-production of science and social order.* London: Routledge, 13-45.

Kahan D. (2013) Making climate-science communication evidence-based. In: Crow D and Boykoff M (eds) *Culture, politics and climate change: How information shapes our common future.* London: Routledge, 203-220.

Kahan D, Peters E, Wittlin M, et al. (2012) The polarizing impact of science literacy and numeracy on perceived climate change risks. *Nature Climate Change* 2: 732-735.

Kuhn T, S. (1962) *The structure of scientific revolutions,* Chicago: University of Chicago Press.

Martin N and Rice J. (2014) Rebalancing climate change debate and policy: An analysis of online discussions. *Environmental Policy and Governance* 24: 338-350.

McGarity TO. (2003-2004) Our science is sound science and their science is junk science: Science-based strategies for avoiding accountability and responsibility for risk-producing products and activities. *University of Kansas Law Review* 52: 897-938.

McKewon E. (2012) Duelling realities: Conspiracy theories vs climate science in regional newspaper coverage of Ian Plimer's book, Heaven and Earth. *Rural Society* 21: 99-115.

Milbrath LW. (1965) *Political participation: How and why do people get involved in politics?,* Chicago: Rand McNally.

Moussaid M, Kammer JE, Analytis PP, et al. (2013) Social influence and the collective dynamics of opinion formation. *PLoS ONE* 8: e78433.

Nisbet MC. (2011) Public opinion and political participation. In: Schlosberg D, Dryzek J and Norgaard R (eds) *Oxford handbook of climate change and society.* London: Oxford University Press, 355-368.

Nisbet MC and Markowitz EM. (2014) Expertise in an age of polarization: Evaluating scientists' political awareness and communication behaviors. *The ANNALS of the American Academy of Political and Social Science* 658: 136-154.

O'Sullivan TM and Emmelhainz R. (2014) Reframing the climate change debate to better leverage policy change: An analysis of public opinion and political psychology. *Journal of Homeland Security and Emergency Management* 11: 317-336.

O'Riordan T and Jordan A. (1999) Institutions, climate change and cultural theory: Towards a common analytical framework. *Global Environmental Change* 9: 81-93.

Painter J. (2011) *Poles apart: The international reporting of climate scepticism,* Oxford: University of Oxford.

Pearce W, Holmberg K, Hellsten I, et al. (2014) Climate change on Twitter: Topics, communities and conversations about the 2013 IPCC Working Group 1 Report *PLoS ONE* 9: e94785.

Poliakoff E and Webb TL. (2007) What factors predict scientists' intentions to participate in public engagement of science activities? *Science Communication* 29: 242-263.

Pralle S. (2009) Agenda-setting and climate change. *Environmental Politics* 18: 781-799.

Ravetz JR. (2011) 'Climategate' and the maturing of post-normal science. *Futures* 43: 149-157.

Ravetz JR. (2012) The significance of the Hamburg workshop: Post-normal science and the maturing of science *Nature and Culture* 7: 133-150.

Rayner S. (2012) Uncomfortable knowledge: The social construction of ignorance in science and environmental policy discourses. *Economy and Society* 41: 107-125.

Schwarz N. (1999) Self-reports: How the questions shape the answers. *American Psychologist* 54: 93.

Seidman I. (2013) *Interviewing as qualitative research: A guide for researchers in education and the social sciences,* New York: Teachers College Press.

Sharman A. (2014) Mapping the climate sceptical blogosphere. *Global Environmental Change* 26: 159-170.

Stehr N and Grundmann R. (2011) *Experts: The knowledge and power of expertise,* Oxford: Routledge.

Thomas D. (2006) A general inductive approach for analyzing qualitative evaluation data. *American Journal of Evaluation* 27: 237-246.

van Eeten MJG. (1999) 'Dialogues of the deaf' on science in policy controversies. *Science and Public Policy* 26: 185-192.

Verheggen B, Strengers B, Cook J, et al. (2014) Scientists' views about attribution of global warming. *Environmental Science & Technology* 48: 8963-8971.

Watts A. (2014) *An extraordinary meeting of climate skeptics and climate scientists in Bath*. Available at: http://wattsupwiththat.com/2014/09/23/an-extraordinary-meeting-of-climate-skeptics-and-climate-scientists-in-bath/.

Weible CM. (2008) Expert-based information and policy subsystems: A review and synthesis. *Policy Studies Journal* 36: 615-635.

Wesselink A, Colebatch H and Pearce W. (2014) Evidence and policy: discourses, meanings and practices. *Policy Sciences* 47: 339-344.

Wojcieszak M and Rojas H. (2011) Hostile public effect: Communication diversity and the projection of personal opinions onto others. *Journal of Broadcasting & Electronic Media* 55: 543-562.

Wolf J and Moser SC. (2011) Individual understandings, perceptions, and engagement with climate change: Insights from in-depth studies across the world. *Wiley Interdisciplinary Reviews: Climate Change* 2: 547-569.

Yeo S. (2014) Climate consensus: scientists and sceptics suspend hostilities. *The Guardian.* 3 October 2014. London: Guardian News and Media Ltd.

Young N and Matthews R. (2007) Experts' understanding of the public: Knowledge control in a risk controversy. *Public Understanding of Science* 16: 123-144.

Zhao X, Rolfe-Redding J and Kotcher JE. (2014) Partisan differences in the relationship between newspaper coverage and concern over global warming. *Public Understanding of Science*, doi: 10.1177/0963662514558992.

Chapter 5. The impact of controversy on the production of scientific knowledge

Abstract

Much of the existing literature employing the framework of controversy focuses on the science-policy interface. However a clear gap exists regarding the way(s) in which controversy may fundamentally shape the production of scientific knowledge itself. This research uses the debate about climate change as a case study to understand the impact of controversy on the production of scientific knowledge, focusing in particular on the interrelated elements of scientific practice and the agency of individual scientists. Based on 63 research interviews with climate scientists, "sceptical voices" about climate change and others, it finds that whereas the majority of climate scientists do not consider sceptical voices to have an impact on scientific practice, the vast majority do identify impacts on scientific agency. The predominant type of agency-related impact is increased caution, followed by disruption, a greater focus on communication, defensiveness and reluctance to publicly engage. It is argued that scientists' ability to distinguish between impacts on agency and practice is both a performative expression of Gieryn's (1999) notion of boundary work and a function of controversy, with the greater the impact of controversy, the less fluid and contingent the boundary between the two. Boundary work is thus a more active and explicit process under conditions of public scientific controversy, as scientists work to ensure the independence and unassailability of their cognitive authority in contested domains. Potential implications for epistemological norms and the social value of science are also identified.

Keywords: Production of scientific knowledge, controversy, climate change, scepticism

5.1   Introduction

As a guiding paradigm, controversies have become an increasingly visible topic in the literature. They magnify and make explicit the 'normally hidden social dimensions of science' (Pinch, 2001: 13719) and highlight the ways in which factors such as political struggles or values debates can influence the role of science in society (Martin and Richards, 1995). To date, the vast majority of controversy-based research has focused

on the ways in which scientific knowledge is used in, or shapes, the policy process (Wynn and Walsh, 2013; Beck et al., 2014; Landström et al., 2015). In particular, engagement between scientists and other social actors, such as the general public, politicians or knowledge brokers, appears to have been the dominant investigative avenue (Wolf and Moser, 2011; Knight and Lyall, 2013; Gluckman, 2014). This has however meant a concomitant lack of attention being paid to how controversy may fundamentally shape the production of scientific knowledge itself, particularly in terms of individual scientists' responses to controversy. This is a critical gap in the literature and is vital to understand for several reasons. Not only may the substantive knowledge gained within disciplinary boundaries be impacted (with, for example, subsequent ramifications for its use as an input to policy decision-making), but wider epistemological norms may also be influenced. These include the types of future scientific enquiry that are carried out, including the appropriateness of specific techniques or modes of investigation, or what the expectations are of scientists as actors in society, such as their role in public or political engagement (Nowotny, 1993; Delborne, 2008; Douglas, 2009). Furthermore, and directly relevant to current debates related to expertise and legitimacy (Suryanarayanan and Kleinman, 2013; Collins, 2014; Nisbet and Markowitz, 2014; Turner, 2014), is the need to understand how scientists are able to make sense of, and retain their cognitive authority in the face of controversy. Accordingly, this research examines the impact of controversy on both the 'material practices that embody the *work* of doing science' (Roosth and Silbey, 2009: 459, emphasis in the original) and on scientists' perceptions of their own agency as producers of scientific knowledge.[1] It thus follows in the footsteps of Latour and Woolgar (1986) by entering the "black box" of scientific knowledge production, and also responds to Longino's (2013) call for greater attention being paid by philosophers of science to 'individual rationality and individual knowledge' in terms of decisions made by scientists as discrete actors within the knowledge production process. It employs Gieryn's (1983; 1999) concept of boundary work to explain scientists' sense-making regarding their perceptions of impact, and provides a conceptual framework of the ways in which controversy may influence the scientific knowledge production process, focusing on the responses of individual scientists.

As has been recognised by many other authors in the field, climate change presents a particularly valuable case study for research into controversy and science (Demeritt, 2001; Demeritt, 2006; Beck et al., 2014; Jankó et al., 2014). Due to its socially-relevant yet complex nature, it illuminates the way that the social trust placed in science (and

scientists) as creators of policy-relevant "facts" can be precarious under conditions of uncertainty. This research focuses on the experiences of climate scientists in two case study locations, New Zealand (NZ) and the United Kingdom (UK). While the majority of the public in both countries agree that climate change is predominantly anthropogenic in origin[2], debate about climate change science is still in evidence (Cooper and Rosin, 2014; Carter, 2014; Tranter and Booth, 2015). In addition to a general undercurrent of scientific contention, controversy also exists in the form of vocal sceptical voices[3] external to traditional modes of scientific enquiry (for examples of overarching arguments and associated framings in the climate debate see Knight and Greenberg, 2011; Capstick and Pidgeon, 2013; Matthews, 2015) and key events such as Climategate.[4]

The next section examines how the existing literature conceptualises responses of scientists under conditions of controversy, followed by outlines of both the climate change debate and the controversy occurring within the two case study locations. Section 5.5 presents the method and is followed by results, discussion and a conclusion.

5.2   Reactions to controversy

In order to understand how controversy may impact the production of scientific knowledge, it is necessary to understand how scientific knowledge comes to be created in the first place. Following Gieryn (1999: xii) the starting point is taken that science is an inherently cultural space, without 'essential or universal qualities' to enable easy definition of its borders. However, in order to structure this investigation, the focus on scientists as knowledge creators suggests attention should be paid to the fundamental and interrelated components of agency and practice. Scientists have active *agency* in their choice and employment of the component *practices* that constitute the "doing" of science. Yet these component practices are also mutually constitutive of scientists' behaviours or agency (Figure 5.1) in what Pickering (1992; 1993; 2010) calls the "mangle". However, outside of sociology of scientific knowledge-based approaches, Merton's (1973 [1942]) influential normative principles describing scientific enquiry, particularly those of disinterestedness and organised scepticism, arguably remain the dominant framing in both the physical science tradition (Kardash and Edwards, 2012; Bucchi, 2015; c.f. Kellogg, 2006) and in the general public's view of science (Jaspal et al., 2013). Within this traditional paradigm, pre-eminence is given to scientific practice, with scientists' agency also framed as objective and instrumental rather than

subjective or co-constructive. Scientists engage in a variety of—supposedly neutral and linear in fashion—activities in order to achieve scientific truth (Latour, 1993). These range from identification of a research topic through to public engagement (shown in a stylised fashion in Figure 5.2 which explicitly focuses on the activities of scientists within formally-designated epistemic communities such as universities). However, drawing inspiration from Mannheim (1936), more sociological understandings of the scientific knowledge production process such as from Gieryn (1999) above and Gibbons et al.'s (1994) theory of Mode 2 knowledge challenge this narrow framing and suggest that science is also a cultural practice, i.e. they bring agency to the fore. Thus the choices made at each step in Figure 5.2 are neither as straightforward in time or space as they may appear, and are inevitably shaped by a myriad of more subjective factors both internal and external to the research process (Nowotny et al., 2001). For example, Lacey (2015: 2) identifies five 'logically distinct, but temporally and causally entangled' moments of scientific activity, ranging from M_1, making decisions about methodology, through to M_5, applying scientific knowledge. He argues that whereas traditional conceptions of knowledge exclude the role of values at, for example M_1, the decision to adopt a particular methodology is an ethical and social choice and thus must be recognised as such.
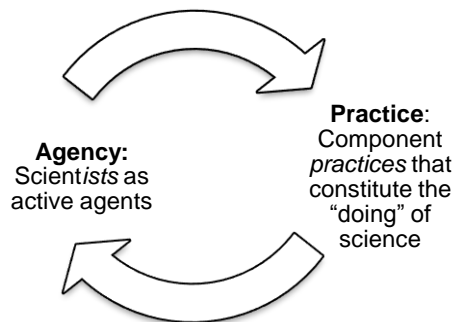
Figure 5.1: Relationship between agency and practice within the scientific knowledge production process
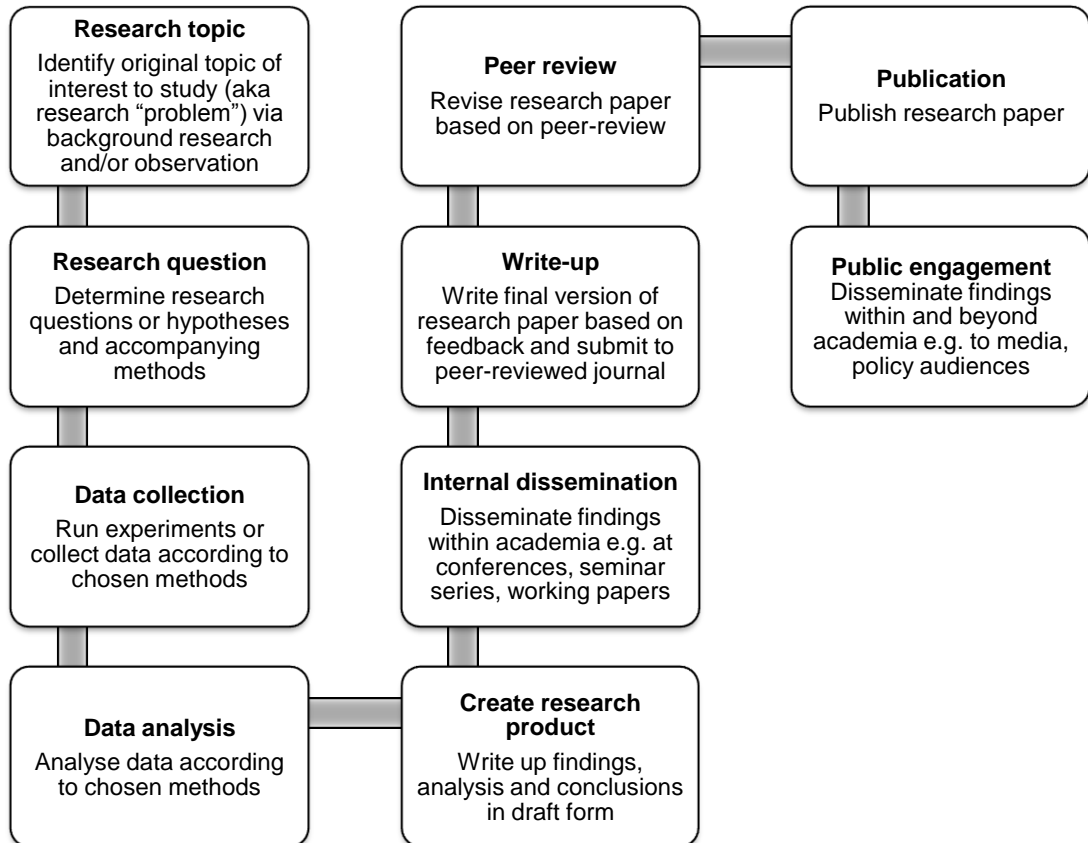
Figure 5.2: Stylised scientific knowledge production process

But how may controversy influence this interplay of agency and practice within the scientific knowledge production process? More socially-attentive interpretations suggest that scientific knowledge claims can be understood as being assembled to support opposing points of view (Pawson, 2006; Sharman and Holmes, 2010), with the "truth" of such claims heavily contested (Sarewitz, 2004; Gulbrandsen, 2008). Epistemic dominance by particular actors in a contentious debate also plays an important role in determining knowledge legitimacy and the resonance of claims (Stehr and Grundmann, 2011; Suryanarayanan and Kleinman, 2013). Factors such as competing values and ideologies (Jasanoff and Wynne, 1998; Douglas, 2009), or varied interpretations of uncertainty (Landström et al., 2015) contribute to the ways in which such claims come to exist and be employed within debate. Moreover, as scientific knowledge is understood to vary in certainty, appeals to uncertainty evident in controversial situations (Skinner et al., 2014) indicate the likelihood of controversy having a differential impact across the scientific process, including the generation of scientific knowledge claims. Controversy may have a stronger influence on more fluid forms of knowledge, such as the difference between the tentative nature of hypotheses

versus the more immutable character of scientific laws, or those less deeply rooted in epistemological norms. For example, attempts to manufacture doubt over the legitimacy of climate science in general (Oreskes and Conway, 2010) have frequently occurred via uncertainty-based challenges to the notion of a consensus (Montford, 2013; c.f. Lewandowsky et al., 2013). Truth is created by moving knowledge up the hierarchy of facticity (Latour and Woolgar, 1986), therefore it is unsurprising that consensus-making has been particularly liable to challenge as a way of delegitimising its influence as an authoritative discourse. But what about impacts on individual scientists as key actors within the knowledge production process? Scientists' decisions shown in Figure 5.2, such as where to site an experiment, what methods to use, or how to appropriately analyse results, are critical to address not only in terms of what they may say about *individual* scientists' agency and practice, but also because they may all be regarded as contributing towards the creation and embedding of (more or less explicit) disciplinary theories and norms (Sandoval and Reiser, 2004).

The existing literature suggests that controversy may influence the scientific knowledge production process, and in particular, the responses of individual scientists, in a variety of ways. Hilgartner (1990) finds that scientists may speak out in defence of their own or colleagues' work when criticised, whereas Negru (2013), examining economists' practices, argues that they have been found to shift the blame for disciplinary shortcomings to other factors. While much of the literature is imbued with a certain normative tone that controversy is uniformly negative, the independent review of Climategate led by Sir Muir Russell (2010) underscored the possibility for increased transparency following controversy. Another strand of research focuses on scientists' resistance to controversy, with scientists either actively (or passively) ignoring controversy (Oliver, 2001) or being unwilling to share data, particularly when requesters are deemed troublesome or with an ulterior motive (Swallow and Bourke, 2012). Gieryn's (1983; 1999) notion of boundary work is also relevant, defined as 'the discursive attribution of selected qualities to scientists, scientific methods, and scientific claims for the purpose of drawing a rhetorical boundary between science and some less authoritative residual non-science' (Gieryn, 1999: 4-5). This concept implies that scientists may respond to controversy by creating expertise-based boundaries between themselves as holders of a special type of cognitive authority and less legitimate "non-scientists". Controversy may result in changes to overarching professional norms within a discipline, as found by Boykoff and Boykoff (2007) when examining journalists' behaviours, and scientists may also be unwilling to discuss or

complain about personal or institutional attacks for fear of reprisals or further incidents (Illman, 2005). What is however also critical to mention is that responses can differ according to the controversy itself. Areas of science that are very public or controversial are likely to impact scientists in different ways to those which are, for example, less immediately policy-relevant or which have less costly ramifications. Whereas the veracity of evolution may be a contested topic in certain environments (Berkman and Plutzer, 2010), it seems unlikely that evolutionary biologists will be personally or professionally impacted by public scientific controversy in the same ways as may a medical researcher using animal subjects (Illman, 2005), an epidemiologist publicly visible in the vaccination debate (Deer, 2011), or a climate scientist. Furthermore, the individual characteristics of a scientist, such as the type of work they do within a discipline or their level of public engagement, are also likely to be very relevant to the impacts experienced under conditions of controversy.

In addition to the above, three further pieces of research are particularly relevant to this study and worthy of discussing in further detail. Lewandowsky et al. (2015), Kempner et al. (2011) and Kempner (2008) introduce the concepts of seepage, forbidden and "nonknowledge", and the chilling effect, respectively. Lewandowsky et al. (2015) suggest that in response to controversy, scientists experience a variety of cognitive and social processes, notably prolonged stereotype threat (feelings of anxiety when reminded of a stereotype held against the group to which they belong), pluralistic ignorance (when those who hold the majority opinion believe they are actually in the minority when a marginal opinion is dominant in public discourse or the media), and third person effect (belief that one is less susceptible to social manipulation than others). They suggest that climate scientists' use of the terms "pause" or "hiatus" to refer to the late 20th century-early 21st century period of global mean surface temperatures is 'a departure from standard scientific practice and is indicative of seepage' (2015: 6), defined as 'the infiltration and influence of what are essentially non-scientific claims into scientific work and discourse' (2015: 2). However, no convincing evidence is presented to demonstrate the assumed relationship between scientists' use of these terms and seepage. For example it is suggested that these terms are a framing 'demonstrably created by contrarians' (2015: 6) and that scientists have, in response, tacitly changed the way they interpret data from that of variability to a pause or hiatus. Critically however, no traceable evidence is included as to the source of these terms (specifically, their supposed origin outside academia and subsequent uptake in the peer-reviewed literature). The overtly normative position that science

ought to be somehow immune to value judgements, as well as so-called 'exogenous pressures' and 'non-experts' (2015: 9) is also concerning as it essentially disregards much of the literature regarding agency within the sociology of scientific knowledge approach that science is, in essence, a human process and that expertise remains a debated concept (Pinch and Bijker, 1984; Longino, 1990; Jasanoff, 2004; Stehr and Grundmann, 2011; Turner, 2014; Evans, 2015). Nonetheless, the question as to potential impact raised by Lewandowsky et al. is clearly relevant here and the paper's limitations emphasise the need for further research to investigate the impact of controversy in detail.

Kempner et al. (2011) suggest that controversy is an important element in the production of so-called "nonknowledge", that is, a factor that impedes the production of scientific knowledge. They argue that scientists learn from past scientific controversies that certain types of knowledge are deemed to be 'forbidden…too sensitive, dangerous, or taboo to produce' (2011: 476). While, due to its more demand-driven nature, the majority of climate change research differs to the examples provided (such as extra-sensory perception, argued to result in "career suicide" for the scientists involved, or socio-politically undesirable topics such as drug and alcohol harm reduction research), this concept is useful in that it indicates that it is possible that certain topics, parts of, or behaviours inherent to the scientific knowledge production process may be regarded as increasingly forbidden. Specifically, public engagement which requires breaching the protective barrier of the academic community, or committing criticisms or analytical strategies to forms liable to become publicly accessible (e.g. to emails which may be obtained through the provisions of freedom of information legislation), may be deemed to be inordinately risky. In a previous piece of research, Kempner (2008) finds that the overarching political environment can shape scientists' research practices via what she terms the "chilling effect" with self-censorship (of both specific terms and entire research topics) a common strategy when scientists had previously been involved in a public scientific controversy. However, she calls for more research into the details of exactly how scientists may respond to external political controversy. By focusing on the detail of changes to the material practices of science this research thus directly responds to Kempner (2008). It also goes further by not only examining impact on scientists in terms of their response to a controversial socio-political environment in general, but also in terms of response to interaction with individuals or groups who provide direct challenges to scientific legitimacy.

5.3 Debate about climate change

Debate about climate change is predominantly presented in both the media and the academic literature as a gaping dichotomy (McCright and Dunlap, 2011; Marquart-Pyatt et al., 2014), with two polarised sides at either end of a chasm of disagreement, claim and counterclaim (Knight and Greenberg, 2011). Scepticism as to the veracity of climate change science has been accused of deepening this gulf, both in terms of influencing public opinion or policy decision-making (Elsasser and Dunlap, 2013; Leiserowitz et al., 2013), but also by negatively impacting the production of climate science and its ability to be regarded as a legitimate input back into decision-making processes (Lahsen, 2008; Washington and Cook, 2011). This interpretation of what is commonly referred to as "climate scepticism" is alleged to impact individual climate scientists in a variety of ways, from the requirement to disseminate (potentially controversial) findings interrupting 'their "real" work… [of] the production of knowledge' (Oreskes, 2014: 120) through to more direct and threatening personal attacks such as those sustained by individual climate scientists (Readfearn, 2012). These have included abusive emails as well as public accusations of so-called "scientific cleansing" of knowledge (Oreskes and Conway, 2010) and are contended to be attempts to question the entirety of climate science, via the discrediting of a few, higher-profile researchers (Mann, 2012). However these narratives are largely anecdotal. Thus not only is the representativeness of claims that scientists have been 'intimidated into neutrality by environmentalism's powerful opponents' (Lynas, 2005: 25) unclear, but the subsequent impacts of controversy on the production of climate science itself is also unknown. Not only is it important to understand how scientific knowledge which pertains to increasingly common, yet complex and "wicked" global issues such as climate change is influenced (Rittel and Webber, 1973; Lorenzoni et al., 2007), it is also of practical consequence as it serves to highlight how scientists and sceptical voices are interacting to alter the course of what is known, and not known, about the changing climate.

5.4 Geographies of contestation

Painter (2011) argues that climate change scepticism is largely an Anglo-Saxon phenomenon, and Capstick and Pidgeon (2013) find that epistemic scepticism (i.e. disputes about the scientific basis of climate change) is a key argument expressed in public discourse. Both NZ and the UK have recently experienced notable epistemic

controversies about climate change, making them ideally suitable as case studies for understanding the impact of controversy on the production of scientific knowledge. In NZ, a small group known as the NZ Climate Science Coalition (NZCSC) formed in 2006 to provide New Zealanders with 'balanced scientific opinions that reflect the truth about climate change and the exaggerated claims that have been made about anthropogenic global warming' (NZCSC, 2007). Operating predominantly at the fringes of the public debate, in 2010 the NZCSC entered squarely into public view by forming the NZ Climate Science Education Trust (NZCSET) and filing a statement of claim in the NZ High Court asking to invalidate the official NZ temperature record kept by the National Institute of Water and Atmospheric Research (NIWA), a Crown Research Institute (CRI)[5] (NZCSC, 2010). In the ensuing court case (NZCSET v NIWA [2012] NZHC 2297) the judgement was handed down in favour of NIWA, with costs also awarded to the defendant (NZCEST v NIWA [2012] NZHC 3560) although it is unlikely that this will be paid given the liquidation of the NZCSET at the end of 2013 (Insolvency and Trustee Service, 2014; Kilgallon, 2014). Hereafter these legal proceedings shall be referred to as the NIWA-CC (court case).

The UK experience has been more extensively covered in the academic literature, although focus has predominantly been directed towards its representation in the news media (Carvalho and Burgess, 2005; Nerlich et al., 2012; Painter and Ashe, 2012). Climategate is widely regarded as a critical moment in the UK climate debate in terms of a challenge to scientific process, and has been subject to numerous analyses, including from a science and technology studies perspective (Ryghaug and Skjolsvold, 2010; Ravetz, 2011; Grundmann, 2012; Ramírez-i-Ollé, 2015) and in terms of its impact on public perceptions of climate change (Koteyko et al., 2012; c.f. Anderegg and Goldsmith, 2014). While the person(s) behind Climategate have never been identified, epistemic scepticism in the UK is also expressed in online forums such as blogs (Sharman, 2014) and by publicly visible organisations, such as the Global Warming Policy Foundation (GWPF)[6] (Painter, 2011).

5.5 Method

Sixty-three semi-structured interviews were conducted between November 2012 and March 2014 across the two case study locations. In-depth discussion enabled a comprehensive appreciation of the rationales and experiences of the actors involved (Seidman, 2013); however, the large number of interviews and subsequent message

saturation that ensued enabled critical analysis to occur. Interviews occurred across three main categories: climate scientist, non-climate scientist academic, and other (Table 5.1). Climate scientists were identified as those working in a university department of physics, geography, earth sciences or environment; or for a government-funded climate-related organisation. Of this category, 93% were PhD-level qualified and were chosen where possible to ensure a wide representation across engagement in the public climate change debate (ranging from very engaged to not at all), type or method of climate science undertaken (such as atmospheric, oceanographic, paleoclimate or statistical climate modelling) and seniority (full-professor level to less than 10 years' experience in the field). Non-climate scientist academics were involved in predominantly social science research on the topic of climate change specifically, or broader theoretical considerations relevant to this research such as the role of science in society. Finally, the category of other was used to classify a broad range of individuals such as journalists, industry or NGO representatives, as well as those identified as "sceptical voices" (who were also identified within the previous categories). This amalgam category of "other" and the lack of further detail regarding numbers of sceptical voices within each category are deliberate choices in order to avoid more specific breakdowns that would likely lead to the identification of interview participants. Individuals referred to as a sceptical voice were identified from sources such as Painter's (2011: 128) 'list of sceptics 'mentioned' more than once in 10 UK national newspapers'; those associated with organisations such as the NZCSC and the GWPF, or, due to online sources increasing importance in the climate debate (Gavin and Marshall, 2011), from Sharman's (2014) list of climate sceptical blog authors. Of the 63 interviews, nine occurred in a UK-based pilot phase and assisted in subsequent interview design.

Table 5.1: Interviews

	NZ	UK	Total
Climate scientist	16	14	**30**
Non-climate scientist academic	7	5	**12**
Other	10	11	**22**
Total	**33** (with 7 or 21% also classed as a "sceptical voice")	**30** (with 10 or 33% also classed as a "sceptical voice")	**63**

Interviewees were asked a variety of questions related to scientific knowledge, such as the role of uncertainty, the value of scientific expertise and the legitimacy of knowledge

claims emerging from climate science. Climate scientists were asked whether those critical of mainstream climate science[7] had an impact on their work, specifically on how they "do science" (i.e. scientific practice). Where possible the wording used to ask this question was that which had been previously used by the interviewee themselves, including "climate sceptics/ism", "the climate debate", or "controversy about climate change". Sceptical voices were also asked a series of questions regarding attempts to articulate their views on climate change, including their perceptions of their own impact on climate science. The data analysis comprised a multi-cycle thematic coding process in order to identify salient issues corresponding directly to the research aim, as well as to identify any other relevant themes. A mixture of coding approaches was employed, such as attribute, descriptive and values coding. Whereas the first coding cycle focused on manifest elements of the data, the second served to identify more latent or abstract components, bringing analytical meaning to the text via what Saldana calls 'themeing the data' (2009: 139). Simultaneous coding (applying two or more codes within a single datum) was frequently employed to capture the complexity of the interview discussion. Coding was conducted both within NVivo10 (following Bazeley and Jackson, 2013) and manually.

5.6 Results

Of those climate scientists who directly responded to the question of whether sceptical voices have had an impact on their scientific practice, i.e. how they "do science" (n=28), the majority (68%) did not perceive any such impact (Table 5.2). Where such impact was perceived, it predominantly focused on an increased conservatism or caution, or changes to the types or focus of research undertaken (Table 5.3). As Table 5.2 shows however, during the interview process the majority (86%) also identified other impacts that influenced their agency as scient*ists* in a more expansive manner than impact on scientific practice alone. These were impacts that either influenced them personally, or the climate science community as a whole, and were described as explicitly different to impact on practice. As NZScientist1 explains, *"they don't have an impact on how we do our science, but they have an impact on what we think about and how we provide explanations for the science, the findings that emerge"* (emphasis in original). This differentiation between impacts on "doing science" (practice) and other parts of their experience as a scientist (agency) was noted within the UK-based pilot phase and was thus explicitly investigated throughout the remaining interviews

(although in the vast majority of cases it was independently identified by the interviewee themselves).

Table 5.2: Climate scientists' perceived impact of sceptical voices

Category of impact		NZ	UK	Total
Impact on scientific practice	Yes	5	4	**9**
	No	9	10	**19**
Impact on scientific agency	Yes	12	12	**24**
	No	2	2	**4**

Table 5.3: Descriptions of perceived impacts on scientific practice

Case study	Description of perceived impact
NZ	"I think it's trained scientists to be ultra-careful what they're saying; to be far **more conservative**" (NZScientist13) "...we are more **rigorous** there than we were before... that's **altered the focus** of a bit of that piece of research" (NZScientist14) "I was very **reluctant** or very **careful** in how I said that because I could see that this could be pulled out of context and used in a way that I, that wouldn't be consistent with what I meant... You can **choose not to show things**, or **put emphasis** in places which you may not have before" (NZScientist2) "I guess all it's done is **influenced the next research projects that I will do** because I want to prove these things are correct" (NZScientist4)
UK	"I think the arguments put forward by sceptics have **shaped the way that I think science should be done**, definitely" (UKScientist2) "Whether it was a direct or indirect consequence of *Climate Audit*, but as some kind of consequence of *Climate Audit*, **a piece of science was re-examined**" (UKScientist3) "You will be able to keep revisiting some of these basics and re-explaining them and that leads you to **look at the data in new ways** and suggests **possible ways for future research**" (UKScientist6)

The most commonly experienced impact related to scientific agency was that of increased caution (Table 5.4). Caution encompassed several distinct elements, from increased attention to scientific findings, *"for a solid year after that [Climategate] at least, Jesus we were crossing every t, dotting every i three times over for fear of getting it right. For fear of anything being wrong, being blown up out of proportion"* (NZScientist12), to the ways in which scientists communicated, particularly via email, *"I write every single email as if it is going to be read by somebody at some point in the future and they are going to be hostile to what they perceive as my intentions. So there's a chance that they will take my reputation down completely"* (UKScientist2). Communication with the media or other actors external to the scientific community was also frequently noted, with UKScientist7 stating that *"we're very, very careful about how we write press releases"*. As UKScientist2 foreshadows above, the overarching rationale underpinning increased caution was a fear of being

misinterpreted, and then subsequently criticised or attacked by actors external to the scientific community on the basis of that misinterpretation. For example, UKScientist13 suggests that *"it probably does make us think more carefully about being as unambiguous and accurate as possible, and try…to avoid situations where we can be accused of misleading people"* and UKScientist11 notes that *"people are now generally afraid about saying anything off the record, maybe on the record even, just what would happen to have it misconstrued"*. Thus whereas two scientists perceived an increase in transparency as a result of sceptical voices (see Table 5.3), the opposite was more commonly acknowledged, with UKScientist7 noting that this fear which results in increased caution meant that *"unfortunately…sometimes you're not quite as open as you could be"*.

Table 5.4: Impact identified by climate scientists on scientific agency

Type of impact	NZ	UK	Total
Caution	8	10	**18**
Disruption	7	4	**11**
Greater focus on communication	4	3	**7**
Defensive	1	5	**6**
Reluctance to publicly engage	2	4	**6**
Awareness of being a target	-	4	**4**
Be more critical	-	3	**3**
Certain types of sceptical voices can accelerate research	1	1	**2**
More transparency	-	2	**2**
Unwanted attention	-	2	**2**
Delay	1	-	**1**
Fewer scientists in the area	-	1	**1**
Involved in new areas of science	-	1	**1**

Notably, caution was both experienced and expressed differently by scientists in the two case study locations. In NZ, caution most often related to the communication of science and how scientists *"think very carefully both about documenting the way we do things in terms of decisions about press releases or what have you and also about thinking carefully about what we say publicly"* (NZScientist3). However, in the UK it was much more closely related to the other themes of awareness of being a target and (subsequently) being defensive. UKScientist2 provided the example of seeing a comment underneath an article in a major UK newspaper on the topic of a climate scientist contemplating suicide: *"So the very point at which I realised that it was really good to have a defence against the dark arts, was that one of the first five comments was 'I wish he had'"*. This expectation of controversy where, for example, UKScientist1 *"knew that it would end with the* Daily Mail *and* The Telegraph *attacking"* was also

frequently communicated to newer scientists in the field. Junior researchers are told to expect that any comments they make publicly will result in *"people… attacking their stuff"* (UKScientist1). In addition to more extreme forms of attack, UKScientist1 also argued that that whereas it can be suggested that *"the only thing that matters to scientists is whether someone's sending you things like hate mail, but the thing that matters actually I would contend is low-level, the drip-drip-drip thing is very important"* and suggested that this constant low-level pressure and expectation of external critique would likely be related to fewer scientists wanting to either remain in or go into climate science. These two themes were thus strongly bound up with reluctance to publicly engage, whereby *"if you beat up scientists long enough, they're just not interested in being dragged through the mud in the popular press"* (NZScientist13).

The second most prevalent theme was that of disruption. Some perceived this as a minor impact more akin to distraction, such as constant requests to respond to claims made in the media: *"you can spend your whole life doing that kind of thing"* (NZScientist1). However, UKScientist9 put forward the more commonly expressed view that *"to say it's a distraction almost trivialises it, which of course it isn't, it's very important"*. In NZ, the *"sheer time-wasting"* (NZScientist12) of scientists involved was associated with a more fundamental point about resource use in a small country. NZScientist5 succinctly summed up this perception:

> *[It is a] political tool for instance to tie up various groups of scientists so that they're always busy constantly answering a stream of questions that are not meant to be constructive in any way, they're meant to be destructive and time-wasting. That's a huge draw on resources in a very, very small place like NZ— both politically and scientifically.*

As Table 5.4 shows, disruption was a more prevalent theme in NZ, and was frequently related to the consequences of the NIWA-CC and the time that a particular group of scientists were required to spend on preparing NIWA's defence. The judge's ruling in favour of NIWA was deemed important not only in the NZ context, but also in terms of potential ramifications in other jurisdictions. As NZScientist16 explains, *"we were told that once the sceptics win the case here they'll start to take them elsewhere, they'll head to Australia to take the case there. I think the Australians are happy we [NZ] won the case"*.

While the majority identified impacts in normatively negative terms, several scientists did identify personally or scientific community-wide positive impacts. The most commonly expressed of these related to communication. Scientists perceived that sceptical voices have *"really turned the climate science community to…thinking about how we communicate climate science"* (NZScientist1). In response, scientists discussed actively engaging with sceptical voices in order to *"find out what the thinking is"* (NZScientist11) or *"trying to understand where it is other people are coming from"* (UKScientist12). They also identified learning from previous experiences and paying constant attention to *"how is this going to be interpreted, how can we make sure that we get this message out smooth and clear so that someone doesn't run away with this sentence or that sentence"* (UKScientist6). This greater focus was thus often bound up with the aforementioned theme of caution, with NZScientist6 noting that *"we tend to be quite cautious then about how we do communicate which is a shame"*. Other, less commonly expressed positive impacts included accelerating particular pieces of research in order to check claims made by sceptical voices, being more attentive to documentation, and increased transparency.

In addition to the specific types of impacts identified, another significant theme was that impact was regarded as being disproportionately borne by particular individual scientists over others. Unsurprisingly, in both NZ and the UK, individual scientists involved in high-profile events (the NIWA-CC and Climategate) were clearly identified as experiencing a larger share of impact with the ensuing ramifications *"pretty devastating for them and their careers"* (UKScientist9). These events may therefore be seen as amplifying mechanisms for controversy. In NZ, scientists who were *"in their prime in terms of their career, their ability to think, their ability to contribute…were robbed of that time and therefore NZ and the world was robbed of their contributions that could have been"* (NZScientist5). In the UK, individual scientists working in *"a big organisation like the Met Office which is high profile in terms of climate change and the whole Climategate thing"* were identified as being at *"high risk"* (UKScientist2) of being attacked. Indeed, any scientist who was recognised as having a public profile was identified as being more likely to be *"put through the wringer"* (UKScientist6). These included scientists involved with the Intergovernmental Panel on Climate Change (IPCC) or those identified as more vocally active generally in the climate change debate. In response, UKScientist8 suggested that whereas many scientists, particularly younger scientists, may be *"more or less oblivious"* to sceptical voices, others who are *"constantly bullied and tyrannised"* may respond by seeing *"it as their mission to stand*

up for their beliefs" despite the fact that *"when you signed up to do science you didn't expect you'd end up in a situation like that"*. Those actively working in climate change science or policy are thus characterised as a *"beleaguered tribe who stand shoulder to shoulder"* against potential attack.

Sceptical voices themselves perceived a diverse range of impacts on climate science and scientists, with a slight majority (56%) identifying some type of impact. Indirect routes via the political process or the media were identified, such as working with politicians to ask questions of government-employed climate scientists, or the media being more critical of scientists' public communications as a result of lobbying by sceptical voices. Others identified impact mostly occurring *"at a personal level"* (UKOther4) as a result of interaction with individual scientists. The notion of climate scientists being more transparent or reigning in more extreme projections as a result of flow-on effects from Climategate or the NIWA-CC was expressed by several sceptical voices, with UKOther2 suggesting that climate scientists are now trying *"harder to be more moderate"* and are *"now nervous about refusing data"* as a result. NZOther5 notes that impact on NIWA in particular has mostly been expressed in terms of changes to the way NIWA publicly engages, suggesting that the NIWA-CC *"has led to them [NIWA] being more circumspect about what they have to say. They're not leaving it to the newspapers now so much; they're sticking more to their science rather than advocacy, which is completely appropriate for a public servant"*. No notable variances were found between NZ and the UK as regards perceptions of impact or mechanisms through which impact was suggested to occur. It is also crucial to note that the categories of climate scientist and sceptical voice are not mutually exclusive. Interviewees who fell into both categories expressed frustration that the climate change debate has become more focused on ideological viewpoints rather than scientific merit. They also described being personally attacked, vilified, excluded and undermined from within the climate science community for their dissenting views. Further research on this population with a larger sample size to ensure anonymity is required for more rigorous and representative findings to be made.

5.7   Discussion

These results provide a number of implications requiring further explanation and analysis. First is a discussion of the types of impacts experienced by scientists. Table 5.5 collates the specific impacts identified here with those found within the existing

literature to provide a conceptual framework of the ways in which controversy may influence the scientific knowledge production process, focusing on the responses of individual scientists. Encompassing scientists' agency and practice, it identifies a spectrum of potential responses from offensive engagement in terms of "rebutting" opposing claims or criticism, to defensive avoidance in terms of "removing" oneself entirely from the controversial situation. This research clearly showed impacts in terms of "reflection", where climate scientists are paying increased attention to accuracy or public communication to avoid misinterpretation; "retreat", in terms of reluctance to publicly engage; and especially "revision", where scientists are increasing cautious regarding scientific process or public communication. It is important to note however that these categories are not mutually exclusive. Indeed, the prevalence of caution and particularly its association with reluctance to publicly engage and defensiveness may be interpreted as a contributory factors in making elements of the climate science knowledge production process regarded as "nonknowledge" (Kempner et al., 2011), classified under "removal" in Table 5.5. Most notably, engagement with the media is viewed as *"very dangerous"* (UKScientist8) career-wise, even though it is perceived to be *"a shame"* (NZScientist6) that scientists are unwilling to *"put their head above the parapet anymore"* (UKScientist12).[8] However, more senior scientists and those who were employed at universities (unlike those at government-funded organisations such as the Met Office or NIWA) were less likely to be concerned about engaging in such behaviours. The ability to speak freely was seen as something particularly highly valued by university-based scientists, as compared to those directly publicly-employed who are subject to *"additional constraints"* (NZScientist6) and are thus *"more pragmatic and grounded in real politik"* (NZScientist7) and cognisant of their *"pay-masters"* or "*pleasing the research council"* (UKScientist12). No clear differences were found in terms of the impact of controversy on different types of climate science undertaken; however a larger sample size may uncover further relationships of this kind.

Table 5.5: Scientists' potential responses to controversy

	Potential response to controversy	
Offensive engagement	Rebuttal	→ Speak out in defence of own or colleagues' work (Hilgartner, 1990) → Shift blame for shortcomings to other factors (Negru, 2013)
	Reflection	→ Increased attention to accuracy in scientific practice → Clarity in public communications to avoid misinterpretation → Increased transparency (Russell, 2010)
	Resistance	→ Actively (or passively) ignore controversy (Oliver, 2001) → Unwilling to share data (particularly when requesters are deemed troublesome or with an ulterior motive) (Swallow and Bourke, 2012) → Boundary work (Gieryn, 1983; Gieryn, 1999)
	Revision	→ Increased caution or hedging in scientific process or public communication → Adopt discourses that shape choice of scientific enquiry ("seepage") (Lewandowsky et al., 2015) → Changes to overarching professional norms (Boykoff and Boykoff, 2007)
	Retreat	→ Reduction in public engagement activities → Unwillingness to discuss personal/institutional attacks for fear of further incidents (Illman, 2005) → Change research behaviours or topics that are "forbidden" so that they become "nonknowledge" (Kempner et al., 2011)
Defensive avoidance	Removal	→ Abandon research project/research career via the "chilling effect" (Kempner, 2008)

The second major implication of this research, and perhaps the result that is particularly striking, is that while the majority of climate scientists do not consider that sceptical voices have any significant impact on scientific practice (how they "do science"), 86% did perceive impacts on their agency as a climate scien*tist*. NZScientist1's claim that sceptical voices don't have an impact on "*how we* do *our science*" but do have an impact on *"what we think about and how we provide explanations for the science"* exemplifies the perception of the majority of scientists interviewed that the nuts and bolts of "doing" science can somehow be clearly differentiated from other elements, such as interpretation of results or interaction with the public or policymakers. It is however difficult to imagine how these may necessarily be disentangled in practice (Pickering, 2010). To take a particularly prosaic example, disruption could arguably be identified as an impact on the "doing of science" because it necessarily implies that science itself is not "being done". And whereas being more cautious and more rigorous were most commonly related to public engagement, it was certainly not restricted to those activities, with many scientists identifying

increased caution throughout the scientific knowledge production process. How therefore is such a distinction able to be made? What might explain how scientists are able to separate so neatly agency and practice within "the mangle" of science? Gieryn's (1983; 1999) theory of boundary work, categorised as a form of "resistance" above, provides a way to explore this conundrum.[9] Scientific practices are, within the positivist scientific tradition, an integral part of the cognitive authority of science. Therefore, to identify the impacts experienced as affecting these practices can clearly be seen as a direct challenge to scientific legitimacy. By making a distinction between impacts on practice and on agency, scientists are thus engaging in boundary work in order to maintain the epistemic authority of science (specifically, the outputs of scientific practice) as a distinct form of knowledge production. In other words, the *very making* of the agency/practice distinction within the interview setting as the scientist responds to questions regarding perceptions of impact *is in itself* a performance of boundary work.[10] Framing impacts in terms of scientific agency is arguably more acceptable as it does not impinge to the same degree upon the legitimacy of the claims emerging from scientific practice. Moreover, the types of impacts that were identified as influencing scientists' agency are largely also able to be formulated according to the notion of the Mertonian ideal. For example, being cautious is a laudable trait as it evokes ideas of preciseness and replicability. This performance of boundary work is important because it provides scientists with a way of coping with the *"discursive fluidity"* (NZAcademic3) and (possibly unexpected) politicisation of the scientific environment evident within controversial situations (Brown, 2015). For those scientists who identified impacts such as caution as influencing their scientific practice (i.e. they agreed that sceptical voices influenced how they "did" science, shown in Table 5.3), it thus also seems possible that that they perceived less of a need to engage in this performative boundary work. Further work involving a larger sample size to determine the variables (such as level of seniority, type of science undertaken or level of engagement with the public or with controversial events) that may be relevant is therefore an important extension of this work.

A third implication of this research is that sceptical voices operating outside the formal epistemic community of science were generally regarded as unable to exert influence until the final product (e.g. a journal article) is made public. However, once this protected "black box" which contains the work of "doing science" has been opened, sceptical voices were then seen to engage in ex-post critiques (which may cycle back through nearly all the stages of the scientific knowledge production process), querying

each micro-decision made by individual scientists in an effort to challenge the science itself or the policy implications of potentially unwelcome scientific findings. Thus, if sceptical voices are making scientists *"much more careful about anything we publish, okay, where are the error bars, where's the statistical significance"* (UKScientist9) it is also likely that these new forms of checking and double-checking may become entangled with the epistemological norms of the discipline itself, and filter back into the ways in which scientists expect themselves and others to behave, particularly in terms of their role as scientific experts. Moreover, if climate scientists are fearful of being attacked and/or misinterpreted, it is also unsurprising that, for example, institutions such as the IPCC are increasingly *"incredibly conservative about what it's said because it's been so terrified not to undermine itself by saying things that can then be shown to be wrong"* (UKScientist8). This echoes Jasper and Poulson's (1993: 642) finding that once an organisation is 'spotlighted by protest', its reputation for credibility and competence are likely to be particularly emphasised by its opponents as a mechanism to challenge legitimacy.

Fourth and finally, the significant events of Climategate and the NIWA-CC not only had considerable impact on scientists' agency and practice, but also on determinations of expertise and the trust placed in climate scientists and, in turn, climate science as a whole. In terms of the former, the NIWA-CC was particularly relevant not only as regards the legitimacy of scientific data and how/who by that legitimacy may be determined, but also in terms of whose expertise is deemed adequately relevant to both produce and criticise knowledge. The presiding judge, Justice Venning, remarked several times in his judgement that the NZCSET plaintiffs did not hold comparable expertise to that of the NIWA scientists: 'He has no applicable qualifications. His interest in the area does not sufficiently qualify him as an expert' (NZCSET v NIWA [2012] NZHC 2297: paragraph 51). Justice Venning argued throughout his decision that the court could not, and should not resolve a scientific debate. Particularly, he contended that the court 'should not seek to determine or resolve scientific questions demanding the evaluation of contentious expert opinion' (NZCSET v NIWA [2012] NZHC 2297: paragraph 48) and in his awarding of costs to the defendant, that the 'issue of whether there is global warming and climate change is a scientific issue, not suitable for determination by a Court' (NZCSET v NIWA [2012] NZHC 3560: paragraph 46). However, in a legal review of the case, Hardcastle (2014: 292) argues that 'the decision offers insufficient protection for scientists and scientific research' because it has, in essence, provided precedent for the High Court of NZ to review research compiled by

CRIs. Hardcastle (2014: 291) contends that CRIs' decisions should only be reviewed in cases of 'fraud, corruption or bad faith', a pre-existing standard established in a 1994 Privy Council determination. She also suggests that research, especially if findings are controversial, may either stagnate or be less likely to be published if scientists are fearful of judicial review. Importantly, criticisms of individual scientists involved in these key events were also perceived to contribute to a reduction in the public's value of, or trust in, science. NZScientist12 argues that not only did the controversy surrounding the NIWA-CC mean that sceptical voices were *"driving the show"*, but that it also required scientists to *"rebuild faith and trust in the public's mind… [due to] that doubt and those seeds that went into Joe Bloggs' mind"*. Climategate was also perceived as *"damaging to climate science because it undermined trust"* which is what *"science relies on"* (UKScientist5) in terms of a public licence to operate. Recognition that those who are publicly visible are those who are more likely to be attacked means it is entirely possible, if not likely, that this would result in less representation from scientists in the public arena. Even if climate scientists perceive it to be part of their "duty" as a scientist to be publicly vocal (Sharman and Howarth, 2015), it is possible that sustained attack, combined with certain scientists' perceptions that they are not able to speak freely given funding or employment status, may limit such activity in practice.

5.8 Conclusion

This research investigated the impact of controversy on the production of scientific knowledge, focusing specifically on impact experienced by individual climate scientists in NZ and the UK. The majority of climate scientists (68%) did not perceive that sceptical voices had an impact on scientific practice; however 86% did identify impact on scientific agency. The predominant type of agency-related impact was increased caution, followed by disruption, a greater focus on communication, defensiveness and a reluctance to publicly engage. Caution was experienced differently within the two case study locations, with implications for the communication of science most prevalent in NZ, and associated with being a target for attack and (subsequently) being defensive in the UK. A very slight majority of sceptical voices (56%) considered that they personally had an impact on climate science/scientists either indirectly through political or media avenues, or via more direct interaction with individual scientists. A conceptual framework of potential response to controversy was provided, ranging from "rebuttal" at the end of offensive engagement to "removal" at the end of defensive avoidance.

Two wider conclusions emerge from this research, with the first related to the distinction between impacts on agency and practice as a form of boundary work. Gieryn suggests that boundary work would be expected in situations where credibility is contested, as the epistemic authority gained by boundary work only exists 'to the extent that it is claimed by some people...but denied to others' (1999: 14). This research extends his argument by contending that boundary work is a more *active* and *explicit* process under conditions of public scientific controversy, as scientists work to ensure the independence and unassailability of their cognitive authority in contested domains. Specifically, scientists' ability or need to explicitly differentiate between impacts on agency and practice within Pickering's (1992; 1993; 2010) "mangle" may therefore be understood as a function of controversy, with the greater the impact of controversy, the less fluid and contingent the boundary between the two. It is thus a coping strategy which protects the dominant paradigm in which one operates as able to provide an accurate or representative truth about the world, rather than just a series of contestable knowledge claims. Delineating who is able to "do science" is thus also likely to be more important in controversial situations as a form of strategic defence. As a result of outside attacks, scientists become protective as to their ability to carry out the constituent activities of science unencumbered. While there was some recognition of exceptions to the rule, such as *"people who do not have PhDs in related fields of science who have a history of doing high, high quality work"* (NZScientist5), markers of expertise such as publishing in the peer-reviewed literature were explicitly argued as critical in being able to identify an individual as a credible voice on climate science. This type of boundary work in terms of attributing legitimacy via pre-existing markers of expertise is not unique to controversial situations (Lamont and Molnár, 2002). However, it seems unsurprising that factors such as entry requirements to conduct scientific practice may be accorded greater importance under conditions of controversy. Nonetheless, further investigation applying both the conceptual framework shown in Table 5.5 and testing the above relationship between impact of controversy and fluidity of the boundary between scientific agency and practice in other case study locations and areas of scientific enquiry is recommended.

Secondly, the predominant impacts experienced, notably increasing caution, perceptions of being under attack and defensiveness, have important implications for epistemological norms and the social value of science. As indicated above, certain climate scientists perceived normatively positive consequences arising from interaction with sceptical voices, including increased attention to detail and rigour in

scientific enquiry, or trends towards greater transparency. "Reflection" is a particularly important category of potential response as public scrutiny may indeed improve the scientific process by making it more publicly accessible or critically self-reflexive. However, a greater number suggested that there was significant reluctance to directly engage with the public or the media for fear of being misconstrued. In particular, being personally attacked, or seeing other, especially well-known scientists attacked, can result in researchers being reluctant to communicate research findings beyond academia or being dissuaded from participating in public fora. If wider communication of results or public engagement becomes regarded as overly risky, a potential consequence is that it may no longer be regarded as a "normal" part of the activities of a scientist (whilst recognising that not all scientists have previously, or would desire to, directly publicly engage). This could lead to increased outsourcing of communication activities to third parties (such as science communication specialists) rather than forming part of (willing) scientists' practices, breaking the direct relationship between scientists and the public that is understood to contribute to public perceptions of the social value of science (Chavis et al., 1983; O'Brien, 2013). Consequences for effective public decision-making may also be experienced, especially if highly publicly controversial research is suppressed or dampened down (e.g. extreme model projections). However, further research is required to provide more concrete examples of the impact of controversy on the policy decision-making process, particularly as regards specific contexts and settings.

5.9 Notes

1. The role of non-human actors as contributors to the scientific knowledge production process is acknowledged (Latour, 1996) but is not the focus of this research.

2. In 2014, 84% of the UK public agreed that climate change is either partly or mainly anthropogenic (Capstick et al., 2015). In 2009, 59.5% of New Zealanders agreed that climate change was caused by humans (Sibley and Kurz, 2013).

3. This paper follows Painter (2011) and Howarth and Sharman (2015) by using "sceptical voice" to move away from the problematic labelling constructs evident in the climate debate. The emphasis on the idea of a "voice" re-focuses on the human (the "who" someone is, rather than the "what") whilst also recognising the need for a pragmatic descriptor.

4. "Climategate" is the colloquial term for the release without authorisation of over 1,000 emails and documents from the University of East Anglia in 2009 on the eve of the United Nation's Framework Convention on Climate Change's 15th Conference of the Parties in Copenhagen.

5. CRIs are registered companies wholly owned by the Crown that carry out scientific research for the benefit of New Zealand.

6. The GWPF is a charity established in 2009 aimed at advancing public understanding about climate change, including potential policy responses. Its chairman, Nigel Lawson, is highly visible in the news media as a sceptical voice (Grundmann and Scott, 2014). In 2014, the GWPF divided in two, adding a campaigning arm (the Global Warming Policy Forum) in response to a Charity Commission investigation finding that its activities were not corresponding to its main purpose as an educational charity (Charity Commission, 2014). Research for this paper occurred prior to this split so all references to the GWPF are to the foundation, not the forum.

7. Mainstream climate science refers to the scientific position on climate change as expressed in the IPCC fourth and fifth assessment reports (2007; 2013).

8. The notion of a parapet or protective walls was interesting, principally in terms of defensiveness and a separation between science and society, and was explicitly referred to 15 times in 12 separate interviews across all interviewee categories.

9. See also Jasanoff (1987) and Ramírez-i-Ollé (2015) for other examples of the use of boundary work in related contexts.

10. It is critical to acknowledge the performative sense-making process that can occur during qualitative research interviews (Lucius-Hoene and Deppermann, 2000; Denzin, 2001; Heiskanen, 2005). The boundary work of making the distinction between agency and practice seen here may be different under different research conditions such as ethnographic research, or survey-based methods.

5.10 References

Anderegg WRL and Goldsmith GR. (2014) Public interest in climate change over the past decade and the effects of the 'climategate' media event. *Environmental Research Letters* 9: 054005.

Bazeley P and Jackson K. (2013) *Qualitative data analysis with NVivo,* London: Sage.

Beck S, Borie M, Esguerra A, et al. (2014) Climate change and the assessment of expert knowledge: Does the IPCC model need updating? *Bridges* 40.

Berkman M and Plutzer E. (2010) *Evolution, creationism, and the battle to control America's classrooms,* Cambridge: Cambridge University Press.

Boykoff JM and Boykoff MT. (2007) Climate change and journalistic norms: A case-study of US mass-media coverage. *Geoforum* 38: 1190-1204.

Brown MB. (2015) Politicizing science: Conceptions of politics in science and technology studies. *Social Studies of Science* 45: 3-30.

Bucchi M. (2015) Norms, competition and visibility in contemporary science: The legacy of Robert K Merton. *Journal of Classical Sociology* 15: 233-252.

Capstick S, Demski C, Sposato R, et al. (2015) Public perceptions of climate change in Britain following the winter 2013/2014 flooding. *Understanding Risk Research Group Working Paper 15-01.* Cardiff: Understanding Risk Research Group, Cardiff University.

Capstick S and Pidgeon N. (2013) What *is* climate change scepticism? Examination of the concept using a mixed methods study of the UK public. *Global Environmental Change* 24: 389-401.

Carter N. (2014) The politics of climate change in the UK. *Wiley Interdisciplinary Reviews: Climate Change* 5: 423-433.

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

Charity Commission. (2014) Operational Compliance Report: The Global Warming Policy Foundation (1131448).

Chavis DM, Stucky PE and Wandersman A. (1983) Returning basic research to the community: A relationship between scientist and citizen. *American Psychologist* 38: 424-434.

Collins H. (2014) Rejecting knowledge claims inside and outside science. *Social Studies of Science* 44: 722-735.

Cooper MH and Rosin C. (2014) Absolving the sins of emission: The politics of regulating agricultural greenhouse gas emissions in New Zealand. *Journal of Rural Studies* 36: 391-400.

Deer B. (2011) How the case against the MMR vaccine was fixed. *BMJ* 342: c5347.

Delborne JA. (2008) Transgenes and transgressions: scientific dissent as heterogeneous practice. *Social Studies of Science* 38: 509-541.

Demeritt D. (2001) The construction of global warming and the politics of science. *Annals of the Association of American Geographers* 91: 307-337.

Demeritt D. (2006) Science studies, climate change and the prospects for constructivist critique. *Economy and Society* 35: 453-479.

Denzin NK. (2001) The reflexive interview and a performative social science. *Qualitative Research* 1: 23-46.

Douglas H. (2009) *Science, policy, and the value-free ideal,* Pittsburgh: University of Pittsburgh Press.

Elsasser SW and Dunlap RE. (2013) Leading voices in the denier choir: Conservative columnists' dismissal of global warming and denigration of climate science. *American Behavioral Scientist* 57: 754-776.

Evans R. (2015) What is expertise? Technical knowledge and political judgement. In: Berling TV and Bueger C (eds) *Security expertise: Practice, power, responsibility.* London: Routledge, 19-36.

Gavin N and Marshall T. (2011) Mediated climate change in Britain: Scepticism on the web and on television around Copenhagen. *Global Environmental Change* 21: 1035-1044.

Gibbons M, Limoges C, Nowotny H, et al. (1994) *The new production of knowledge: The dynamics of science and research in contemporary societies,* London: Sage.

Gieryn TF. (1983) Boundary-work and the demarcation of science from non-science: Strains and interests in professional ideologies of scientists. *American Sociological Review* 48: 781-795.

Gieryn TF. (1999) *Cultural boundaries of science: Credibility on the line,* Chicago: University of Chicago Press.

Gluckman P. (2014) Brokering knowledge: Giving science advice to government. *Public Sector* July/August: 4.

Grundmann R. (2012) The legacy of climategate: Revitalizing or undermining climate science and policy? *Wiley Interdisciplinary Reviews: Climate Change* 3: 281-288.

Grundmann R and Scott M. (2014) Disputed climate science in the media: Do countries matter? *Public Understanding of Science* 23: 220-235.

Gulbrandsen LH. (2008) The role of science in environmental governance: Competing knowledge producers in Swedish and Norwegian forestry. *Global Environmental Politics* 8: 99-122.

Hardcastle L. (2014) Can't see the science for the solicitors: Judicial review of scientific research in light of NIWA's case. *New Zealand Journal of Public and International Law* 12: 291-320.

Heiskanen E. (2005) The performative nature of consumer research: Consumers' environmental awareness as an example. *Journal of Consumer Policy* 28: 179-201.

Hilgartner S. (1990) The dominant view of popularization: Conceptual problems, political uses. *Social Studies of Science* 20: 519-539.

Howarth C and Sharman A. (2015) Labeling opinions in the climate debate: A critical review. *Wiley Interdisciplinary Reviews: Climate Change* 6: 239-254.

Illman J. (2005) Animal rights violence spreads fear through U.K. research community. *Journal of the National Cancer Institute* 97: 1565-1566.

Insolvency and Trustee Service. (2014) Insolvency summary report: New Zealand Climate Science Education Trust. Ministry of Economic Development Insolvency and Trustee Service.

IPCC. (2007) Climate change 2007: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. In: Solomon S, Qin D, Manning M, et al. (eds) *IPCC Fourth Assessment Report.* Cambridge: Cambridge University Press.

IPCC. (2013) Climate change 2013: The physical science basis. Working Group I contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. In: Stocker TF, Qin D, Plattner G-K, et al. (eds) *IPCC Fifth Assessment Report.* Cambridge: Cambridge University Press.

Jankó F, Móricz N and Papp Vancsó J. (2014) Reviewing the climate change reviewers: Exploring controversy through report references and citations. *Geoforum* 56: 17-34.

Jasanoff S. (2004) States of knowledge: The co-production of science and social order. London: Routledge.

Jasanoff S and Wynne B. (1998) Science and decisionmaking. In: Rayner S and Malone EL (eds) *Human choice and climate change. Volume 1: The societal framework.* Columbus OH: Battelle Press, 1-83.

Jasanoff SS. (1987) Contested boundaries in policy-relevant science. *Social Studies of Science* 17: 195-230.

Jaspal R, Nerlich B and Koteyko N. (2013) Contesting science by appealing to its norms: Readers discuss climate science in the Daily Mail. *Science Communication* 35: 383-410.

Jasper JM and Poulsen J. (1993) Fighting back: Vulnerabilities, blunders, and countermobilization by the targets in three animal rights campaigns. *Sociological Forum* 8: 639-657.

Kardash CAM and Edwards OV. (2012) Thinking and behaving like scientists: Perceptions of undergraduate science interns and their faculty mentors. *Instructional Science* 40: 875-899.

Kellogg D. (2006) Towards a post-academic science policy: Scientific communication and the collapse of the Mertonian norms. *International Journal of Communications Law & Policy*, Special Issue, Access to Knowledge: 1-29.

Kempner J. (2008) The chilling effect: How do researchers react to controversy? *PLoS Med* 5: e222.

Kempner J, Merz JF and Bosk CL. (2011) Forbidden knowledge: Public controversy and the production of nonknowledge. *Sociological Forum* 26: 475-500.

Kilgallon S. (2014) Failed doubters trust leaves taxpayers at loss *The Dominion Post.* Wellington. Available at http://www.stuff.co.nz/environment/9600410/Failed-doubters-trust-leaves-taxpayers-at-loss.

Knight C and Lyall C. (2013) Knowledge brokers: The role of intermediaries in producing research impact. *Evidence & Policy: A Journal of Research, Debate and Practice* 9: 309-316.

Knight G and Greenberg J. (2011) Talk of the enemy: Adversarial framing and climate change discourse. *Social Movement Studies* 10: 323-340.

Koteyko N, Jaspal R and Nerlich B. (2012) Climate change and 'climategate' in online reader comments: A mixed methods study. *The Geographical Journal* 179: 74-86.

Lacey H. (2015) 'Holding' and 'endorsing' claims in the course of scientific activities. *Studies in History and Philosophy of Science Part A*, doi: 10.1016/j.shpsa.2015.05.009.

Lahsen M. (2008) Experiences of modernity in the greenhouse: A cultural analysis of a physicist "trio" supporting the backlash against global warming. *Global Environmental Change* 18: 204-219.

Lamont M and Molnár V. (2002) The study of boundaries in the social sciences. *Annual Review of Sociology* 28: 167-195.

Landström C, Hauxwell-Baldwin R, Lorenzoni I, et al. (2015) The (mis)understanding of scientific uncertainty? How experts view policy-makers, the media and publics. *Science as Culture*: 1-23.

Latour B. (1993) *We have never been modern,* Hemel Hempstead: Harvester Wheatsheaf.

Latour B. (1996) On actor-network theory: A few clarifications. *Soziale Welt* 47: 369-381.

Latour B and Woolgar S. (1986) *Laboratory life : The construction of scientific facts,* Princeton, NJ: Princeton University Press.

Leiserowitz A, Maibach EW, Roser-Renouf C, et al. (2013) Climategate, public opinion, and the loss of trust. *American Behavioral Scientist* 57: 818-837.

Lewandowsky S, Gignac GE and Vaughan S. (2013) The pivotal role of perceived scientific consensus in acceptance of science. *Nature Climate Change* 3: 399-404.

Lewandowsky S, Oreskes N, Risbey JS, et al. (2015) Seepage: Climate change denial and its effect on the scientific community. *Global Environmental Change* 33: 1-13.

Longino HE. (1990) *Science as social knowledge: Values and objectivity in scientific inquiry,* Princeton: Princeton University Press.

Longino HE. (2013) The social dimensions of scientific knowledge. In: Zalta EN (ed) *The Stanford Encyclopedia of Philosophy (Spring 2013 Edition).* Stanford, CA: Stanford University.

Lorenzoni I, Jones M and Turnpenny JR. (2007) Climate change, human genetics, and post-normality in the UK. *Futures* 39: 65-82.

Lucius-Hoene G and Deppermann A. (2000) Narrative identity empiricized: A dialogical and positioning approach to autobiographical research interviews. *Narrative Inquiry* 10: 199-222.

Lynas M. (2005) Get off the fence; Scientists have been intimidated into a polite silence about climate change. It is time they spoke out, for all our sakes. *New Scientist.* 25.

Mann ME. (2012) *The hockey stick and the climate wars: Dispatches from the front lines,* New York: Columbia University Press.

Mannheim K. (1936) *Ideology and utopia,* London: Routledge.

Marquart-Pyatt ST, McCright AM, Dietz T, et al. (2014) Politics eclipses climate extremes for climate change perceptions. *Global Environmental Change* 29: 246-257.

Martin B and Richards E. (1995) Scientific knowledge, controversy, and public decision-making In: Jasanoff S, Markle GE, Petersen JC, et al. (eds) *Handbook of science and technology studies.* Newbury Park, CA: Sage, 506-526.

Matthews P. (2015) Why are people skeptical about climate change? Some insights from blog comments. *Environmental Communication* 9: 153-168.

McCright AM and Dunlap RE. (2011) The politicization of climate change and polarization in the American public's views of global warming, 2001–2010. *Sociological Quarterly* 52: 155-194.

Merton RK. (1973 [1942]) The normative structure of science. In: Merton RK (ed) *The sociology of science: Theoretical and empirical investigations.* London: The University of Chicago Press, 267-278.

Montford A. (2013) Consensus? What consensus? London: The Global Warming Policy Foundation.

Negru I. (2013) How reflexive have economists been in the wake of the crisis: 'The times they are a –changin'? Post Keynesian Economics Study Group Working Paper 1306. Available at: https://www.postkeynesian.net/downloads/wpaper/PKWP1306.pdf.

Nerlich B, Forsyth R and Clarke D. (2012) Climate in the news: How differences in media discourse between the US and UK reflect national priorities. *Environmental Communication* 6: 44-63.

Nisbet MC and Markowitz EM. (2014) Expertise in an age of polarization: Evaluating scientists' political awareness and communication behaviors. *The ANNALS of the American Academy of Political and Social Science* 658: 136-154.

Nowotny H. (1993) Socially distributed knowledge: Five spaces for science to meet the public. *Public Understanding of Science* 2: 307-319.

Nowotny H, Scott P and Gibbons M. (2001) *Re-thinking science: Knowledge and the public in an age of uncertainty,* Cambridge: Polity.

NZCSC. (2007) New Zealand Climate Science Coalition, http://nzclimatescience.net/.

NZCSC. (2010) High Court asked to invalidate NIWA's official NZ temperature record (press release). Auckland, New Zealand: NZCSC, Available at: http://nzclimatescience.net/images/PDFs/niwa.ct.docs.pdf.

NZCSET v NIWA [2012] NZHC 2297. New Zealand Climate Science Education Trust v National Institute of Water and Atmospheric Research Ltd [2012] NZHC 2297.

NZCSET v NIWA [2012] NZHC 3560. New Zealand Climate Science Education Trust v National Institute of Water and Atmospheric Research Ltd [2012] NZHC 3560.

O'Brien TL. (2013) Scientific authority in policy contexts: Public attitudes about environmental scientists, medical researchers, and economists. *Public Understanding of Science* 22: 799-816.

Oliver C. (2001) Strategic responses to institutional processes. *Academy of Management Review* 16: 145-179.

Oreskes N. (2014) The scientific consensus on climate change: How do we know we're not wrong? In: DiMento JFC and Doughman P (eds) *Climate change: What it means for us, our children, and our grandchildren.* Cambridge, MA: MIT Press, 105-148.

Oreskes N and Conway EM. (2010) *Merchants of doubt: How a handful of scientists obsured the truth on issues from tobacco smoke to global warming,* New York: Bloomsbury Press.

Painter J. (2011) *Poles apart: The international reporting of climate scepticism,* Oxford: University of Oxford.

Painter J and Ashe T. (2012) Cross-national comparison of the presence of climate scepticism in the print media in six countries, 2007-10. *Environmental Research Letters* 7: 044005.

Pawson R. (2006) *Evidence-based policy: A realist perspective,* London: Sage Publications.

Pickering A. (1992) *Science as practice and culture*: Chicago: University of Chicago Press.

Pickering A. (1993) The mangle of practice: Agency and emergence in the sociology of science. *American Journal of Sociology* 99: 559-589.

Pickering A. (2010) *The mangle of practice: Time, agency, and science,* Chicago: University of Chicago Press.

Pinch TJ. (2001) Scientific controversies. In: Smelser NJ and Baltes PB (eds) *International encyclopedia of the social & behavioral sciences.* Oxford: Pergamon, 13719-13724.

Pinch TJ and Bijker WE. (1984) The social construction of facts and artefacts: Or how the sociology of science and the sociology of technology might benefit each other. *Social Studies of Science* 14: 399-441.

Ramírez-i-Ollé M. (2015) Rhetorical strategies for scientific authority: A boundary-work analysis of 'Climategate'. *Science as Culture*: doi: 10.1080/09505431.09502015.01041902.

Ravetz JR. (2011) 'Climategate' and the maturing of post-normal science. *Futures* 43: 149-157.

Readfearn G. (2012) 'You overpaid, overeducated parasite': ANU climate scientist emails. *Crikey.* Australia: Private Media Pty Ltd.

Rittel HWJ and Webber MM. (1973) Dilemmas in a general theory of planning. *Policy Sciences* 4: 155-169.

Roosth S and Silbey S. (2009) Science and technology studies: From controversies to post-humanist social theory. In: Turner BS (ed) *The new Blackwell companion to social theory.* Chichester: Blackwell Publishing Ltd, 451-474.

Russell M. (2010) The independent climate change e-mails review. London. Available at http://www.cce-review.org/.

Ryghaug M and Skjolsvold TM. (2010) The global warming of climate science: Climategate and the construction of scientific facts. *International Studies in the Philosophy of Science* 24: 287-307.

Saldana J. (2009) *The coding manual for qualitative researchers,* London: Sage Publications Ltd.

Sandoval WA and Reiser BJ. (2004) Explanation-driven inquiry: Integrating conceptual and epistemic scaffolds for scientific inquiry. *Science Education* 88: 345-372.

Sarewitz D. (2004) How science makes environmental controversies worse. *Environmental Science & Policy* 7: 385-403.

Seidman I. (2013) *Interviewing as qualitative research: A guide for researchers in education and the social sciences,* New York: Teachers College Press.

Sharman A. (2014) Mapping the climate sceptical blogosphere. *Global Environmental Change* 26: 159-170.

Sharman A and Holmes J. (2010) Evidence-based policy or policy-based evidence gathering? Biofuels, the EU and the 10% target. *Environmental Policy and Governance* 20: 309-321.

Sharman A and Howarth C. (2015) Climate stories: Why do climate scientists and sceptical voices participate in the climate debate? *Centre for Climate Change Economics and Policy Working Paper No. 216, Grantham Research Institute on Climate Change and the Environment Working Paper No.191.* London: LSE.

Sibley CG and Kurz T. (2013) A model of climate belief profiles: How much does it matter if people question human causation? *Analyses of Social Issues and Public Policy* 13: 245-261.

Skinner DJC, Rocks SA and Pollard SJT. (2014) A review of uncertainty in environmental risk: Characterising potential natures, locations and levels. *Journal of Risk Research* 17: 195-219.

Stehr N and Grundmann R. (2011) *Experts: The knowledge and power of expertise,* Oxford: Routledge.

Suryanarayanan S and Kleinman DL. (2013) Be(e)coming experts: The controversy over insecticides in the honey bee colony collapse disorder. *Social Studies of Science* 43: 215-240.

Swallow D and Bourke G. (2012) The Freedom of Information Act and higher education: The experience of FOI officers in the UK. Department of Political Science, UCL.

Tranter B and Booth K. (2015) Scepticism in a changing climate: A cross-national study. *Global Environmental Change* 33: 154-164.

Turner S. (2014) *The politics of expertise,* Oxford: Routledge.

Washington H and Cook J. (2011) *Climate change denial: Heads in the sand,* London: Earthscan.

Wolf J and Moser SC. (2011) Individual understandings, perceptions, and engagement with climate change: insights from in-depth studies across the world. *Wiley Interdisciplinary Reviews: Climate Change* 2: 547-569.

Wynn J and Walsh L. (2013) Emerging directions in science, publics, and controversy. *Poroi* 9: 1-5.

Chapter 6. Post-decisional logics of inaction: The impact of climate controversy on policy decision-making

Abstract

Contestation over knowledge claims, including their legitimacy as an input to policy decision-making, does not end at the moment of policy creation. Policies continue to be made and unmade during the implementation phase and climate change policy is no exception. Building on Puchala's (1975) concept of post-decisional politics, we investigate the implementation of climate change policy in New Zealand and the United Kingdom and find influential post-decisional logics of inaction diluting and undermining climate policy implementation in both countries. In the United Kingdom, contestation over scientific knowledge claims is found to be a significant feature of the policy landscape, with sceptical voices seen to exert direct influence on policy decision-making processes. Conversely, knowledge contestation has limited to no influence in New Zealand, where political rationales in the form of the current national economic interest and cost-based arguments prevail. Explanatory factors such as structural economic considerations and different values placed on science as an input to policymaking are discussed, highlighting the importance of being attentive to the place-based characteristics of post-decisional logics of inaction.

Keywords: climate change, controversy, policy, scepticism

6.1   Introduction

A growing number of states have committed themselves to ambitious climate mitigation policies (Nachmany et al., 2015). Much of the research into these policies has focused on their formulation and adoption. However, less well understood is what happens after the initial legislative act, including the factors shaping the subsequent enactment of domestic climate policy. This is an important gap. There is long-standing recognition that policies continue to be made—and, moreover, unmade—during the implementation stage (Lipsky, 1979). Indeed, increasing evidence suggests that many climate mitigation policies have failed to live up to their original ambitions, as decision-

makers have sought to water-down commitments in practice (Viola and Franchini, 2014; Newman and Head, 2015).

The aim of this paper is to investigate the logics invoked by actors that have proved influential in delaying, diluting or otherwise undermining the implementation of climate policy, or which are used by decision-makers to justify policy inaction. In exploring these logics, we employ two conceptual frameworks. The first is that of knowledge controversy, defined by Whatmore (2009: 588) as 'events in which the knowledge claims and technologies of environmental science, and the regulatory and policy practices of government agencies that they inform, become subject to public interrogation and dispute.' While the existing literature provides valuable insights into the reasons behind controversy surrounding climate change, such as differences of worldview (Hulme, 2009; Hoffman, 2015), less attention has been paid to the role of knowledge controversy in impacting public policy. We use the framework of knowledge controversy to make three contributions to the literature. First, and perhaps most importantly, we investigate whether knowledge controversy is itself a significant factor influencing climate policy implementation. It could be that other considerations that are not predicated upon dispute over knowledge may be more influential in certain contexts. Second, we investigate whether and how different forms of knowledge controversy matter, focusing specifically on controversies (nominally) predicated on science and policy claims. And third, we examine the role of place, and the degree to which domestic cultural, political and economic factors impact the salience of knowledge controversy in the implementation of climate policy.

The second framework is Puchala's (1975) concept of post-decisional politics which highlights 'who influences whom to do what, when, how, and why' (1975: 497) once policies are executed. We build on this to introduce the concept of post-decisional logics of inaction. We define these as resonant arguments that provide the rationale for maintenance of the status quo, or increased conservatism, despite the intended aims of enacted policy. We contend that post-decisional logics of inaction are likely to be especially apposite in the case of climate mitigation—not least because it may only be during the implementation stage that the details of policies are fully worked out and the true costs of climate action become apparent. Actors whose interests are threatened, or are otherwise critical of climate action, are thus anticipated to mobilise against policy using logics of inaction which they believe are likely to prove influential amongst bureaucratic or political decision makers. Indeed, the literature has long

recognised how certain arguments (or frames) presented by actors can prove influential in public policy debates, mobilising support, opening windows of opportunity and legitimising certain courses of action (Grolin, 1998; Hannigan, 2014). Logics of inaction may invoke knowledge controversy or, alternatively, may be predicated upon considerations other than dispute over science and policy knowledge claims.

In order to investigate these logics, we focus on two industrialised countries which were early-movers in climate policy adoption, the United Kingdom (UK) and New Zealand (NZ). The UK is recognised as a climate pioneer, with the 2008 Climate Change Act enshrining legal commitments to dramatically reduce greenhouse gas (GHG) emissions by at least 80% by 2050. Concomitantly, NZ was the first country to implement an ambitious "all sectors, all gases" emissions trading scheme (the NZ-ETS). Yet, against a backdrop of active debate about climate change, both these flagship policies have experienced a number of post-implementation set-backs (Bullock, 2012; Carter and Clements, 2015). We suggest that such implementation "failures" cannot simply be explained by recourse to institutional factors such as inadequate resources or principle-agent problems (Howlett, 2012). Rather, other possibilities must also be considered, such as issues of political economy, or as the result of ongoing knowledge contestation, as sceptical voices[1] (defined intentionally broadly as actors critical of knowledge claims emerging from climate change science and/or policy) seek to undermine the grounds for climate action.

We begin by unpacking the potential relevance of knowledge controversies in the area of climate change before examining the literature regarding the post-decisional politics of climate change. After identifying the post-decisional logics of inaction occurring in both countries we conclude that while scientifically-based knowledge controversy has impacted the resourcing and prioritisation of climate policy implementation in the UK, it has had little or no impact in NZ. Instead, underscoring the place-based nature of knowledge controversy, we find that political rationales in the form of the current national economic interest and cost-based arguments have prevailed.

6.2   Knowledge, controversy, inaction and place

As defined by Whatmore (2009) above, knowledge controversies are events in which knowledge claims and associated policy practices are subject to public dispute. We

build on her definition to argue that knowledge controversies are also inherently political in nature. That is, they are fundamentally about *whose* evidence, opinions, arguments and framings are influential, and *whose* politics and science come to have authority within a contested domain. This interpretation thus also references Beck's (1992) concept of the politics of knowledge, defined by Grundmann (2007: 417) as the 'instrumental use of knowledge claims for the achievement of political goals'. The concept of knowledge controversies is especially pertinent in this context as climate change is an issue where conflicting knowledge claims and valuations of evidence and expertise have been assembled to support different points of view within a contentious, highly divisive public debate (Demeritt, 2001; Ryghaug, 2011).

Two streams of previous research are relevant to understanding the impact of knowledge controversy in the context of climate change. The first, deriving largely from the United States (US) experience, has examined the political activities of sceptical voices. This work has explored the strategies deployed by anti-regulatory groups to undermine political action on climate change, including by attacking the credibility of the science of climate change, or else the scientists who produce it, as well as challenging the assumed costs of various mitigation policies (McCright and Dunlap, 2003; Layzer, 2007). It has also investigated the role of the media in the production and reproduction of knowledge controversy (Boykoff, 2007; Painter, 2011).

A second stream of work, which has largely been situated within literature concerned with the nature of disputes over climate change, has sought to categorise sceptical voices and/or the different types of knowledge claims being made in the climate change debate by sceptical voices. That controversy exists about both the science and politics of climate change is unsurprising as there will inevitably be winners and losers from any climate policy attempting to cause, or resulting in, fundamental structural changes to national economic settings (Skodvin et al., 2010). In addition to disputes regarding climate policy, controversy about underpinning scientific claims is also evident, and is particularly understandable given the argument that 'the construction of science *is* the construction of credibility' (Mahony, 2014: 96, emphasis in the original).

Following this division, Capstick and Pidgeon (2013) distinguish between response and epistemic scepticism. The former encompasses doubts about the effectiveness of climate policy, as well as the willingness and ability of actors to implement and carry

out such policies, and the latter based on scientific factors. Yet it is important to note that these categories are not mutually exclusive. Much policy-related controversy is not solely limited to doubts as to the effectiveness of policy, or the willingness behind implementation, but is, albeit often implicitly, tied to the scientific rationales for such policy in the first place, thus combining the two categories together. Indeed, Van Rensburg (2015: 4) identifies what he calls 'process scepticism' which is based on critiques of the scientific *and* political processes underlying the creation of climate change knowledge. Nonetheless, these categories of science and politics are useful as a basic heuristic device to highlight the different explicit framings through which knowledge controversy may influence policy decision-making. Thus knowledge contestation may be (a) ostensibly based on the expression of scientific doubt or (b) based around debates where the potential impacts of various policy choices are disputed via the assemblage of conflicting knowledge claims. A third possibility is (c) that policy decision-making is shaped by arguments which are not subject to knowledge contestation. The policy consequences of such arguments may well generate controversy. Yet the important point is that, in such cases, the knowledge itself which forms an input into the policy decision-making process is not itself disputed.

These categories help to direct attention towards three important, under-researched questions. The first is the degree to which knowledge controversy and battles over cognitive legitimacy affect policy decision-making during the implementation stage. It could be that knowledge controversy matters if sceptical voices are successful in exploiting the uncertainty about knowledge aspects of science or policy amongst political or bureaucratic actors. Alternatively, it may be that knowledge controversy has little or no impact, with rationales other than those focused on questions of knowledge resonating amongst decision-makers.

A second question is which particular aspects of knowledge controversy may matter. Evidence suggests that sceptical voices have invoked both scientific and policy aspects in public discourse (Jaspal et al., 2015). We seek to provide new understanding into which of these articulations of controversy have proved influential in shaping the debate over climate change. One might expect policy-focused contestation to be prominent given the behavioural or cost implications of certain types of climate change policies (Whitmarsh, 2009; Fudge and Peters, 2011). Yet less clear is whether science-based disagreements at the policy adoption stage (Layzer, 2007), also retain salience

following policy implementation. It is within this context that we introduce the notion of post-decisional logics of inaction in order to identify which arguments achieve saliency, credibility and purchase over policy decision-makers at the implementation stage.

The third question examines whether and how particular different logics assume resonance more in some places than others. Inspiration to examine the place-based nature of knowledge controversies draws from previous work identifying national-level differences between sources of dispute over contentious issues (Scoones, 2008; Vogel, 2012). It also responds to work in political ecology which recognises that environmental controversies are deeply rooted in local political, cultural and economic institutions (Forsyth, 2012). An important issue in the present context is why certain logics of inaction are likely to prove more influential in certain places than others. These include logics of inaction predicated on aspects of knowledge controversy, or logics that are framed outside of cognitive disputes over science or policy. We identify two sets of (interrelated) factors. The first stems from the power of sceptical voices and other claims-makers, their strategic choices over how to frame arguments, and their capabilities to use particular logics to shape the choices of decision-makers. Apposite in this regard are factors such as the existence of domestic political opportunity structures, group resources, political acumen and actors' ability to present a unified position. A second set of factors focuses on resonance of these logics amongst decision-makers. This, in turn, is likely to depend on domestic cultural politics, political settings, strategic priorities and the bargaining power of different groups. For example, arguments framed around economic costs are likely to have greater weight where affected industries can impose a credible and substantive threat (Vining et al., 2005; Skodvin et al., 2010). It is also likely to partly be a function of how logics articulated by sceptical voices have issue linkage with concerns, imperatives and priorities of the wider public (Hannigan, 2014).

6.3   The post-decisional politics of climate change

In investigating whether and how the knowledge controversy surrounding climate change affects policy implementation, our work links to a long-established literature which has sought to explain the gap between policy objectives, intent and aspirations, and subsequent policy action in practice (Lipsky, 1979; Bardach, 1977). A number of different factors have been argued to explain this divergence although, in reality, they

often interact to shape policy outcomes. One set are institutional in nature. These include institutional capacity, institutional fragmentation and principal-agent problems (Dimitrakopoulos, 2001; Howlett, 2012).

While institutional factors have a role in shaping the implementation of climate policy (Ryan, 2015), a second set of factors which are broadly political in nature are also critical. The significance of political factors stems from the fact that, as long recognised in the literature (Bardach, 1977; Lipsky, 1979), policies continue to get made during implementation. As a result, politics frequently carries over from the policy adoption phase into the implementation phase, in the sense that the period following policy adoption continues to require a series of choices by decision-makers, the influence of interests and the exercise of power (Dimitrakopoulos, 2001).

Political factors are likely to be especially important at the implementation stage in the case of climate change for a number of reasons. One is that both executives and legislatures may adopt climate change policies for a wide range of motives. A key rationale for the adoption of climate change legislation is the substantive goal of reducing GHG emissions. However, as well as 'issue-related substantive' reasons, political actors may also adopt policies for 'political-strategic' purposes (Newig, 2007: 279). Within the context of climate change, these motives include: relief from domestic societal pressure to act; prestige from assuming international leadership on climate change; external legitimacy from conforming to norms of environmental responsibility; and avoiding stigma arising from a failure to sign-up to legally-binding mitigation commitments. Motives are important because they potentially spill over into implementation. In particular, climate policies adopted for political-strategic reasons can be interpreted as a form of symbolic politics, primarily aimed at reassuring others by creating the impression that "something is being done" (Blühdorn, 2013). In reality, political actors may lack the intent or resolve to follow through on commitments enshrined in symbolic legislation, making implementation vulnerable to anti-regulatory interest groups or various economic and political vagaries including recessions (Bache et al., 2014). Policies may thus include purposefully vague or ambiguous goals, or include commitments to long-term targets which allow governments to avoid taking aggressive action in their period of office.

Another reason why climate policy implementation is frequently political is that, as with other policy areas, primary legislation may be highly general in nature. That is,

rather than laying out detailed rules and regulations, it may only specify goals, objectives or mitigation commitments. Indeed, climate mitigation legislation can often be interpreted as meta-policy, intended to guide the subsequent development of more detailed policy settings carried out by administrative bodies (Bache et al., 2014). That the specific details of climate change policies are, to a greater or lesser extent, elaborated and resolved at the implementation stage has several important implications. The first is that political debate and opposition may increase after policy enaction when many critical decisions with associated cost and adjustment implications are made and that true costs of climate change policy for target groups becomes apparent (Ryan, 2015). Indeed, precisely because certain "flagship" meta-policy has focused on long-term mitigation goals, opposition at the adoption stage can remain relatively muted or else ineffective (Carter, 2014). A second, associated, implication, is that affected interest groups and other critical parties may be more likely to, or be more successful at, politically mobilising at the implementation stage.

The concept of post-decisional politics neatly captures these dynamics, recognising that the period following policy adoption may be characterised by a series of choices, political influences and institutional constraints on action (Dimitrakopoulos, 2001). We suggest that this concept is especially resonant in the case of climate change, where the period following the adoption of policy has been accompanied by political debates, manoeuvring and interest group politics. These dynamics are of academic interest for two key reasons. First, they challenge highly stylised accounts which portray climate change politics as somehow apolitical and little more than a technocratic exercise in the shadow of an assumed political consensus. Whilst the politics of climate change have not always been radical, as envisioned by prominent Marxist observers (Swyngedouw, 2010), we nevertheless witness an active political debate in many countries over the issue. Second, the post-decisional politics of climate change reveals something important about the ways in which highly divisive knowledge controversies may continue to play out during the implementation phase of policy, and moreover which aspects of controversy have the greatest influence over policy in the form of post-decisional logics of inaction. It is this issue which is the primary focus of the present paper.

6.4 Climate change politics

6.4.1 New Zealand

NZ's GHG emissions profile differs radically from that of most other developed nations, with nearly half total emissions comprising methane and nitrous oxide from agriculture, followed by energy, industrial processes and product use, and waste (Figure 6.1). Net GHG emissions increased 111% between 1990-2012 to 49.4 $MtCO_2$-e (MFE, 2014). Agriculture contributes approximately half of the country's export earnings, with dairy comprising 55% of this total (NZ Government, 2015b). Three GHG emissions reduction targets below 1990 levels exist: an unconditional target of 5% by 2020; a conditional target of 10-20% by 2020 providing a comprehensive global agreement is reached; and, gazetted under the 2002 Climate Change Response Act in 2011, a target of 50% by 2050 (NZ Government, 2015a).
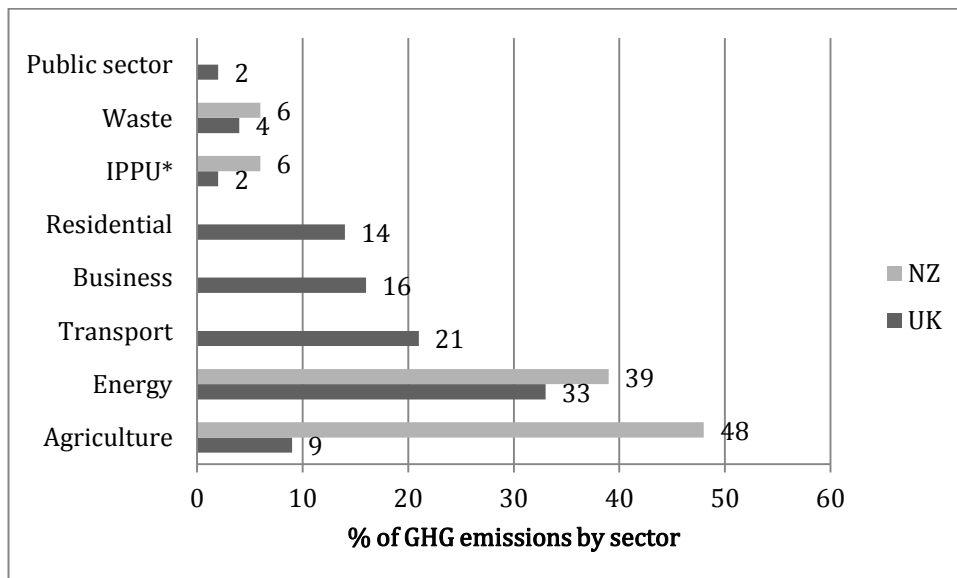
Figure 6.1: NZ and UK net GHG emissions, percentage by sector 2013

* Industrial processes and product use

Source: (DECC, 2015; MFE, 2015a)

Debate over climate change emerged in the late 1980s. Pressure groups such as the now-defunct Greenhouse Policy Coalition (representing a consortium of the country's largest industrial GHG emitters) and agricultural lobby groups have played a key role in influencing government policy choices (Bullock, 2012; Barry and King-Jones, 2014). Reforming a framework established in the 2002 Climate Change Response Act, the NZ-ETS was established in 2008. Agriculture was initially scheduled to enter the NZ-ETS in

January 2015, but due to intense opposition (Cooper and Rosin, 2014) was indefinitely, and controversially, excluded in 2012 (Mason, 2013).[2]

Kelly (2010: 9) has identified three key factors contributing to what he terms a 'major policy implementation deficit' in NZ climate policymaking: the dominant role of business-focused interest groups opposing regulatory intervention; short-term discourses regarding protection of the country's (land-based) economic competitiveness; and, an influential legacy of neo-liberal market-focused ideology. While NZ was a signatory to the Kyoto Protocol during its first commitment period (2008-2012), in 2012 the Minister of Climate Change, Tim Groser, announced that the then-Government would not sign up to a second period and would instead aim to participate in a new, as yet unidentified, convention (Associated Press, 2012). Explicitly scientific contestation about climate change has been mainly limited to the arguments put forth by the NZ Climate Science Coalition (NZCSC). The NZCSC has had a limited public profile, but in 2010 formed the NZ Climate Science Education Trust. This trust filed a statement of claim in the NZ High Court seeking to invalidate the official NZ temperature record kept by the state-owned National Institute of Water and Atmospheric Research (NIWA), (NZCSC, 2010). The court case was won by NIWA, but its members remain active in public discussion about climate change (TVNZ, 2014).

6.4.2   The United Kingdom

In the UK, net GHG emissions decreased by 28% between 1990-2012 to 582.2 $MtCO_2$-e (DECC, 2015). The vast majority of emissions are from carbon dioxide (82% in 2013), followed by methane (10%), nitrous oxide (5%) and fluorinated gases (3%). The energy sector accounts for the largest share of overall emissions, followed by transport, business, residential, and agriculture (Figure 6.1). A legally binding target of at least an 80% reduction in GHG emissions compared to 1990 levels by 2050 exists as part of the 2008 Climate Change Act (CCA), with an interim target of a 50% reduction by 2025. Within the CCA a series of five-yearly "carbon budgets" exist as a mechanism to ensure targets are met. However, the Committee on Climate Change (CCC) has warned that the lack of policies focused on the post-2020 period is causing uncertainty and 'risks failing to meet legal obligations to reduce emissions' (CCC, 2015).

A review of UK climate change politics by Carter (2014) suggests that, following a period of limited public interest and vigorous opposition to policy action by business

interests, a window of opportunity opened between 2006-2010 allowing climate change to rapidly move up the political agenda during a period of "consensus politics". However, Carter and Clements (2015) argue that climate change can no longer be understood as a valence issue in UK political discourse. Rather, that it has become increasingly positional and partisan, akin to the divided political debate evident in the USA (Guber, 2013; Hess, 2014). Indeed, such divisions were apparent in the last Coalition government, particularly between more right-of-centre elements of the Conservative Party and the Liberal Democrats (Macalister, 2014), with Carter (2014: 429) observing 'growing discontent [post-2010] among Conservative MPs, the wider party and the right wing press toward many of the Government's emission reduction measures'. The most well-known body opposing climate action in the public UK debate is the Global Warming Policy Foundation (GWPF) (Painter, 2011), established in 2009. The GWPF actively disseminates information about both the scientific and policy dimensions of climate change and its chairman, Nigel Lawson, is highly visible in the news media as a sceptical voice (Grundmann and Scott, 2014).

6.5   Method

Semi-structured interviews with 99 individuals occurred between November 2012 and March 2014. Interviewees were categorised as academic, policy, politician, scientist or other (Table 6.1). Within this number, 20 interviews were conducted with individuals further classified as sceptical voices[3]. Interviewees were asked whether they considered sceptical voices, "climate scepticism" or controversy about climate change in general (using, where possible, the language previously employed by the interviewee themselves), had an influence on contemporary (i.e. post-implementation of flagship policy) domestic policy decisions made about climate change. Interview data was analysed using thematic coding in NVivo10 (Bazeley and Jackson, 2013) and manually. Impact on policy decision-making was classified into three groups: direct, indirect and no impact. Indirect impact included influences that the respondent themselves thought was circuitous or removed directly from the direct policy-making process—for example, via influence on public opinion.

Table 6.1: Interviews

		NZ	UK	Total
Academic	Social scientists working on climate change or related issues	7	5	**12**
Other	Media, NGO or industry representatives	10	11	**22**
Policy	Officials presently or previously working on climate change for state or city/regional-level policy departments, or independent policy advisory agencies	17	10	**27**
Politician	Sitting members of Parliament; political party spokespeople on climate change, environment or energy; or city/regional-level politicians	4	5	**9**
Scientist	Scientists working on climate change in a university department of physics, geography, earth sciences or environment; or for a government-funded climate-related organisation	16	14	**20**
Total		**54**	**45**	**99***

* Including 20 interviewees classified as sceptical voices.

6.6 Post-decisional logics of inaction

A clear and consistent narrative emerged from the interview process. The majority of respondents in NZ, particularly policy officials, did not consider that sceptical voices exerted a direct impact on policy decision-making, yet the opposite was the case in the UK (Table 6.2). Two further findings are notable. First, if direct and indirect responses are collated, a substantial majority (87%) of UK respondents perceived that sceptical voices impacted policy decision-making yet it still did not become the dominant opinion in NZ. Second, taking just policy officials' and politicians' viewpoints into account, an even starker difference between the two contexts is evident. All bar one respondent in the UK considered sceptical voices to have either a direct or indirect impact on policy decision-making. In NZ, only eight politicians and policy officials considered sceptical voices to have either a direct or indirect impact on policy decision-making, compared to 13 who did not. The following sub-sections examine these results in more detail, focusing on the logics of inaction evident in each country context.

Table 6.2: Perception of impact of sceptical voices on policy decision-making

Case study	Category	Type of impact		
		Direct impact	Indirect impact	No impact
NZ	Academic	2	-	1
	Other	1	5	3
	Policy	2	4	11
	Politician	2	-	2
	Scientist	4	-	4
	Total	*11 (27%)**	*9 (22%)*	*21 (51%)*
UK	Academic	2	1	-
	Other	3	4	3
	Policy	8	1	1
	Politician	2	1	-
	Scientist	3	1	-
	Total	*18 (60%)*	*8 (27%)*	*4 (13%)*

* Percentages are based on 71 interviewees who directly gave an opinion.

6.6.1 New Zealand: A dominant national interest story

The overwhelmingly dominant post-decisional logic of inaction evident in NZ was the pre-eminence of the current national economic interest, centred on the protection of the country's agricultural base in order to ensure the cost-competitiveness of dairy in the global marketplace. The indefinite exclusion of agriculture from requirements to surrender emissions units under the NZ-ETS in 2012 provides a concrete policy manifestation of this logic of inaction. As NZPolicy3 argued, *"why are we taxing our cows when we're one of the more efficient producers, and no other country is taxing theirs?".* Disconnect between the initial policy ambition of the NZ-ETS and its current status was frequently highlighted by interviewees. NZPolicy9 noted that *"our policy has effectively been watered down...the evidence becomes stronger it seems and our scheme gets weaker",* but also recognised that there were a number of *"legitimate political and probably economic reasons why making our scheme weaker makes sense for NZ at the moment".* Moreover, the very existence of the NZ-ETS, as well as the exclusion of agriculture, has meant that climate change as a whole is regarded as having *"disappeared, absolutely"* from the political agenda of the Government because *"politically the ETS has made it all go away"* (NZPolicy2). The effectiveness of this logic of inaction is unsurprising, not least due to warnings issued following the NZ-ETS launch that unless 'other countries include agriculture [in equivalent pricing mechanisms] the comparative advantage of NZ agriculture will diminish with little if any reductions in global emissions' (Jiang et al., 2009: 78). Indeed, an important feature of the current national economic interest logic is that its underlying knowledge

claims have gone largely uncontested, in the sense that it is broadly accepted that the agricultural sector would incur substantive cost burdens from full participation in the NZ-ETS.

The influence of the current national economic interest logic of inaction has been bolstered by two other factors. One is ongoing political uncertainty regarding the prospects of a binding international climate mitigation agreement. This uncertainty is important because NZ is unwilling to risk its national competitive advantage by making internationally unreciprocated policy commitments. Lobby groups are *"using the political uncertainty to their advantage"* (NZOther3), such as by making threats to move business offshore should more stringent policies be implemented. The second contributory factor is the demonstrative, symbolic political value of the NZ-ETS in maintaining NZ's international credibility and legitimacy. Whereas NZ chose not to sign up to a second commitment period of the Kyoto Protocol, specifically citing its rationale as acting in the country's best interests (Groser, 2012), the NZ-ETS, even in its current incarnation, is regarded as acting as a mollifying signal of enacted climate policy to the international community. NZPolicy6 explained that *"it can appear to be a, 'we'll try to get away with as little as possible, do just enough to politically hold some credibility around it, but only just enough'"*. This desire for credibility is important as *"NZ has a primary interest in being seen as a good global citizen"* (NZPolicy17) in order to secure access to global trade deals. This post-decisional logic of inaction also rests on an explicit "*fair share*" (NZPolicy3) basis, with the phrase "Doing our fair share" one of the six main headlines on the NZ Government's main climate change website (NZ Government, 2015a). The underlying argument is that the country *"shouldn't be trying to stay ahead of the pack when it's costly"* (NZPolicy1).

In terms of the scientific basis for climate change policy, while there is seen to be a *"very strong acceptance of climate change by ministers and ministries"* (NZPolicy13), scientific rationales were not viewed as having a *"conscious and open impact, an explicit impact on decision-making"* (NZPolicy17). Critically, whereas scientific considerations were seen to contribute towards the rationale for policy development, they were regarded as being nearly absent from the policy implementation phase. Relatedly, while *"the sceptic debate was quite strident"* (NZPolicy2) at the formation stage of the NZ-ETS, it was largely seen as having *"had its battles and lost"* (NZPolicy3). Notable in this regard is the observation that the country's largest agricultural lobby, Federated Farmers, has switched from questioning the scientific basis for climate

change towards a position of questioning the need for action. Politicians were also widely seen by respondents as being dismissive of sceptical voices, particularly those who frame their arguments in scientific terms and who are seen to be *"running interference rather than being constructive"* (NZPolicy1). Indeed, sceptical voices such as the NZCSC who openly base much of their opposition to climate policy on scientific grounds are seen as increasingly side-lined in terms of political credibility. While one such sceptical voice considered that *"we might have had a bearing"* (NZOther5) on reducing domestic policy ambition, the majority concurred with NZOther6 who considered their impact to be *"fairly small"*. The global financial crisis was also identified as a contributory factor in reducing the need for politicians to position any criticism of climate policy upon a foundation of scientific uncertainty. Thus, whereas scientifically-based scepticism exists in the NZ context, it is not regarded as a legitimate policy discourse, and does not act as an influential logic of inaction.

6.6.2   The United Kingdom: The continued relevance of scientific doubt

In stark contrast to the NZ context, sceptical voices were seen by the majority of respondents, particularly policy officials and politicians, as exerting direct influence on UK climate change policy decision-making at the implementation stage. While the CCA provides a solution of architecture, post-decisional political conservatism was clearly apparent, with the most notable post-decisional logic of inaction being the expression of scientific doubt. For example, UKPolicy3 identified *"a highly-organised, very well-funded group…whose job it is to try and undermine everything the climate science community is doing"* and UKPolicy5 suggested that *"most cabinet ministers remain unconvinced about climate science and warm to the GWPF's position rather than the IPCC Fifth Assessment report"*. However the pathway of influence for scientific arguments was recognised as complex. Whereas *"very few UK politicians are out-and-out climate denying"* (UKPolicy5), scientific rationales are contributing to a *"fog of distrust"* (UKPolicy10) around the need to actively move forward on implementing policies which would achieve agreed carbon budgets and mandated emissions targets. It was thought unlikely that the CCA would be repealed or significantly altered in the near term, but this scientifically-based logic of inaction was clearly seen as contributing towards *"not just a slowing down but blockages"* (UKPolicy6) in terms of active policy implementation. Critically, scientifically-based arguments provide *"a fig leaf for certain policy inaction"* by *"draining political capital…from mitigative action on climate change"* (UKScientist14). Since the passing of the CCA in 2008, it was argued that UK

climate change policy *"did backtrack…[as] the climate sceptics' arguments came up and we didn't address them or just they became more vocal or people used them as an excuse to ignore it when they actually just didn't want to pay for action or change behaviours"* (UKPolicy9). In contrast to the policy development stage, UKPolicy5 states that several years after the passing of the CCA *"we barely use the word climate, and even in internal documents the word climate is rarely used"*. UKPolicy4 provides a concrete example of the impact of this logic of inaction:

> *It manifests itself in terms of the resources going into the CCA… You can soft peddle; you can really do the minimum. What we've seen compared to the first cycle of the climate change risk assessment and national adaptation programme and planning, the resource that went into that. We're seeing this time round, just a fraction of that, a tenth of the resources.*

The role of individual political figures who are either not convinced of the veracity of climate science, or who use scientific arguments to justify particular policy positions, was also noted. In terms of direct influence on policymaking, Owen Paterson, former Secretary of State for Environment, Food and Rural Affairs, was the most frequently mentioned individual. Paterson was seen to have *"very little interest in climate change, putting it politely"* (UKPolicy4) due to his scepticism of scientific knowledge claims such as the legitimacy of existing and forecast global warming measurements (Paterson, 2014). In addition to Paterson, it was also *"widely thought that under the current political leadership of the Treasury, the former chancellor Lord Lawson has a disproportionate influence"* (UKPolicy6). Groups such as the GWPF were deemed significant as *"they are loud and they get a lot of airtime"* (UKPolicy3), with interviewees recounting stories of politicians receiving emails from the GWPF *"pointing to various different particular findings every day"* which is *"putting the centre of gravity a bit in a particular direction"* (UKPolicy8). Lobby groups are *"trying to push forward this message that not only is it not worth doing anything about climate, not only should we not subsidise uneconomic renewables but let's forget climate change because it's not an issue anymore"* (UKPolicy1). These discourses are seen to make it difficult for politicians to make decisive decisions due to their successful casting of scientific doubt and, furthermore, impact the working processes of policy officials. For example, UKPolicy1 contended that sceptical voices *"try to absorb as much of our time as possible before conferences of the parties and things like that… to keep us busy so that we're not doing what we should be doing"*. Impacts on policy

officials are important, particularly given recognition of their vital role in shaping and influencing policy on an ongoing basis (Page and Jenkins, 2005).

Other, less dominant, logics of inaction were also present in the UK context. It was regarded as an *"unhappy coincidence of timing that the financial crisis came"* (UKPolicy9) at the same time as the CCA was passed, thus giving more relevance to immediate national economic interest arguments. As in NZ, costs are regarded as *"bottom line politics"* (UKPolicy4), influenced by, for example, linkages made in the media between rising household energy bills and subsidies for renewable energy policies (Doyle, 2015). Thus the national economic interest argument *"intuitively strikes a chord with quite a lot of people and decision-makers, and businesses can forever cite them whether or not they have evidence"* (UKPolicy8). The concept of fairness was also noted, as *"why should British businesses suffer under environmental burdens no-one else has to bear?"* (UKPolicy5). Critically however, unlike in NZ, these cost-based logics were seen to be explicitly predicated upon framings of scientific doubt, with a clear relationship between perceptions of policy necessity and opinion of the legitimacy of underlying scientific knowledge claims. In essence, the costs of so-called "green" policies were able to be framed as unnecessary because the notion that the underlying science was uncertain achieved resonance with policy decision-makers.

It is also important to mention that, while the majority of respondents considered sceptical voices to be influencing policy decision-making in the UK, there were differences regarding the strength of impact in terms of a direct cause-and-effect relationship. For example, UKPolicy8 considered the impact on government policy to be *"far less than would be perceived or expected"* and UKPolicy10 said they could not *"see a clear line between that and decisions that get made"*. A key reason for such opinions was the existence of the statutory obligations which form part of the CCA (including legal requirements to annually report progress on meeting emissions targets). Moreover, while several sceptical voice politicians considered that they *"absolutely"* (UKPolitician2) had an impact on policy and that this was increasing over time, the majority of non-politician sceptical voices were more reticent. For example, UKOther3 thought he had impact *"only in a very small way"* and UKOther5 perceived achieving *"a little bit"* of impact. The role of the media as a conduit for sceptical voices' arguments (which are then reflected back to politicians via constituency members or opinion polls) was also highlighted, with UKPolicy10 arguing that information from the

GWPF *"has most weight when it's actually picked up...and put in the mainstream press".*

6.7 Unravelling contrasting logics

The above results provide evidence of influential, albeit contrasting, post-decisional logics of inaction in both NZ and the UK which have constrained the implementation of climate policy. The existence of the current national economic interest and cost-based logics apparent in NZ are not surprising, with the indefinite removal of agriculture from the NZ-ETS chiming with Bartram and Terry's account of a long history of 'goal deflation' (2010: 31) in NZ climate change politics. Most recently, this has been apparent in the decision by the Government in 2015 to downgrade its emissions target to 30% below 2005 levels by 2030, effectively adding an additional decade to the previous goal (MFE, 2015b). Likewise, evidence from the interviews points to a reduction in prioritisation and resourcing for the implementation of the CCA in the UK, echoing recent work which points to a cooling political appetite to aggressively pursue climate change policy (Carter, 2014; Carter and Clements, 2015; Bache et al., 2014).

In NZ, despite goal deflation, climate change remains a topic of public concern, regularly ranking in public opinion polls as the most important environmental issue facing the world (Hughey et al., 2013). However, only 6% of the population thinks that climate change is the most important environmental issue facing NZ itself (Hughey et al., 2013). This suggests that for NZ, climate change exists largely as an *external* problem, strongly linked with outward-facing issues of trade, exports and international competitiveness. The dominant post-decisional logic of inaction, emphasising the *current* national economic interest, also has a clearly temporal aspect. It indicates an emphasis on short-term political considerations at the expense of longer-term consequences and suggests that the dominance of this post-decisional logic of inaction is strongly linked to high social discount rates for both environmental and economic factors.

In the UK, political economic rationales such as debates about the cost implications of climate change policies were also present. Yet what is a much more puzzling result is that it was only in the UK that explicitly scientifically-based arguments were also regarded as holding cognitive authority as a post-decisional logic of inaction. This difference in terms of the salience of knowledge claims centred on scientific doubt may

be explained by several factors. One suggestion offered during the interview process was a lack of scientific knowledge amongst UK parliamentarians. However, more Members of Parliament (MPs) have a scientific background in the UK as do in NZ (8% in the UK in 2008 versus 4% in NZ in 2014) (Miller and Blackham, 2014; Goodwin, 2015). Moreover, scientific training has also been shown to have no independent effect on UK MPs' voting behaviour (Goodwin, 2015), limiting the persuasiveness of this rationale. Another, more compelling argument however is that there exists an *"inherent distrust [not] of scientists, but of science-informed policy"* (UKPolicy2) which, for many respondents, made climate change policy challenging to implement. Apposite in this regard is the "perfect storm" of science-based contestation about climate change that occurred in early 2010 (Leiserowitz et al., 2013). Within a matter of months, Climategate[4] (particularly resonant in the UK due to its occurrence at the University of East Anglia), the political failure of the Copenhagen United Nations Framework Convention on Climate Change (UNFCCC) negotiations and errors related to rates of glacial melt found in the IPCC (2007) report were all highlighted by the UK media (Hoffman, 2011; Anderegg and Goldsmith, 2014) as well as by lobby groups such as the GWPF. The emphasis on epistemic uncertainty and scientific misconduct were key narratives that appeared to resonate strongly with both the UK public and policymakers (Nerlich, 2010; Grundmann, 2012). This is unsurprising given both recent public scientific controversies still fresh in the public consciousness such as the bovine spongiform encephalopathy (BSE) crisis and the badger cull (Lodge and Matus, 2014; Naylor et al., 2014), as well as previous evidence demonstrating the successful use of uncertainty and doubt by lobbyists in public scientific debates in the USA (Michaels, 2008; Oreskes and Conway, 2010). It has long been recognised that the strategic choices made by individuals or groups intending to influence policy need to be attuned to context in order to ensure receptiveness on behalf of decision-makers (Milbrath, 1960; Binderkrantz and Kroyer, 2012; De Bruycker, 2014). It seems likely that individuals disputing climate policy in the UK may have identified the successful use of scientifically-based arguments as a strategy which aligned well with the context of the domestic policy environment. Relatedly, the political acumen of lobby groups using scientifically-based arguments also appears to be much greater in the UK as compared to NZ. As indicated above, the GWPF directly and regularly contacts MPs to express its viewpoint, and, crucially, is chaired by a previous Chancellor of the Exchequer, suggesting a degree of insider credibility in the policy process.

A second contributory factor is the value placed on science within each context. The UK has a strong history of evidence-based policymaking, with explicit emphasis on the value of science as a decision-making input (Holmes and Clark, 2008). For example, the UK has a much more extensive network of chief scientific advisors compared to NZ (one per government department as compared to one for the whole of government), and indeed, as compared to many other Westminster-based systems of government (Lalor and Hickey, 2014). In terms of climate change in particular, the existence of the CCC which is legally mandated to provide scientific advice on the 2050 target, carbon budgets and emissions is also an influential element to consider. Given the importance accorded to science as a rationale *for* policy, it seems understandable that science would therefore be accorded equally significant weight as a mechanism with which to *dispute* policy. This relationship has been argued as particularly pertinent for environmental issues given their heavy reliance on scientific evidence (Demeritt, 2006; Jacques et al., 2008). While evidence-based policymaking is valued in NZ (Gluckman, 2013), it may be possible that institutional structures and the centuries-long(er) history of scientific endeavour in the UK leads to a greater awareness and thus recognition of its ability to inform policy. It is however important to also recognise that debate exists regarding the continued value of science as an input into the UK policy process (Demeritt, 2000). Indeed, UKPolicy4 suggested that there has been a *"drop-off in our value of science"*, so it is possible that the prevalence and authority of scientifically-related knowledge contestation may concomitantly reduce over time.

Finally, structural considerations are also likely to be relevant. As Figure 6.1 shows, the majority of NZ's GHG emissions originate from a single source (the agricultural sector) whereas the UK emissions profile is more diverse. In NZ, a clear relationship exists between the inclusion of agriculture in the NZ-ETS and the country's immediate economic performance (particularly in terms of international trade), such that the dominance of economic logics is understandable. Conversely in the UK, a more complex relationship exists between the myriad climate policies under the framework of the CCA, the different sectors that comprise the economy, and overall national economic performance. Critically, this complexity thus provides fertile ground for arguments predicated on scientific doubt, whereas in NZ, there is no need or space to invoke scientific arguments as the current national economic interest effectively crowds out other logics. This does not deny the well-documented relationship between political ideology and the use of scientific logics to argue for a reduction in regulatory burden (McCright and Dunlap, 2010), but helps to explain why in NZ, where ideological

opposition to climate change regulation exists in terms of free-market fundamentalism (Kelly, 2010), scientific uncertainty is a less powerfully resonant post-decisional logic of inaction.

6.8   Conclusion

There is growing recognition that the ambitions enshrined in an emerging body of climate mitigation legislation are not being fully realised during the actual implementation of accompanying policy (Ryan, 2015). Our goal in the present paper was to investigate this discrepancy through an analysis of 99 interviews in NZ and the UK. We introduced the concept of post-decisional logics of inaction to describe arguments or rationales used by actors in the climate change debate to dilute, delay or slow the implementation of formally adopted policy. We found two contrasting post-decisional logics of inaction in the two case-study countries. The dominant logic in NZ centred on a largely uncontested (in terms of knowledge claims) national economic interest argument. Conversely, the most influential post-decisional decisional logic of inaction in the UK was that of scientific doubt, with national economic interest arguments only playing a secondary role.

Our findings have wider implications for debates about knowledge controversy and the impact of controversy on policy decision-making (Sharman and Holmes, 2010; Marris et al., 2005; Suhay and Druckman, 2015). As revealed by the example of NZ, arguments which are used to roll-back on the implementation of climate policy are not necessarily predicated on the uncertainty, ambiguity or veracity of knowledge. That is, knowledge controversy is not always part of a political strategy to undermine climate mitigation, not least where there is limited ambiguity about the consequences of policy. Hence, a particular feature of the NZ case is that few disputed claims that including agriculture in the NZ-ETS would be costly, or that it would have significant consequences for the competitiveness of the country's dairy exports.

In other contexts, however, knowledge controversy may feature prominently. In the UK, scientific-based controversy has been used instrumentally by sceptical voices to create a "fog of distrust" in order to achieve a reduction in prioritisation and resourcing for the CCA, the country's principal climate change policy. At one level, the success of this strategy is surprising, in that it is sometimes assumed that the scientific case for climate policy is now largely settled (Cook et al., 2013). Yet unlike in NZ, the national

economic interest case against implementing climate change policy is less clear-cut (Bassi and Zenghelis, 2014), creating a political space for controversy. Moreover, potential distrust about science-based policy provides more fertile ground for arguments based on scientific uncertainty to be deployed in order to achieve political goals. What this suggests is that, under particular conditions, the politics of knowledge may stretch beyond the oft-discussed science-policy interface at the early policy formulation and adoption phase (Wesselink et al., 2013). Where ambiguity can be effectively exploited, science-based knowledge controversy may also continue to shape policy decision-making during subsequent implementation.

Of note, there was very little evidence that policy-based knowledge controversy significantly impacted the implementation of climate policy in either context, even though several interviewees acknowledged its existence in the UK. These included a number of sceptical voices who, as well as casting doubt over the science of climate change, actively sought to challenge policy-based knowledge (e.g. about the cost or effectiveness of particular policies, such as financial support mechanisms for renewables). Again, this likely reflects the receptiveness of the domestic environment to scientific uncertainty, as opposed to policy uncertainty. Regardless of the true underlying reason, however, our findings indicate that scientific and policy aspects of knowledge controversy do not necessarily hold the same salience.

Indeed, a key insight to emerge from the present study is that the politics of knowledge and post-decisional logics of inaction are far from universal across space, but are place-based in that they are embedded in particular economic, political and cultural contexts. Arguments which are effective in undermining, diluting and delaying the implementation of climate policy do not hold universal purchase. Whereas Painter (2011) argued that climate change scepticism was an Anglo-Saxon phenomenon, even in two Anglo-Saxon countries with a number of political and cultural similarities, the resonance of different rationales for policy decision-making have been highly context-dependent. While similar logics were noted in both case study locations (economic interest arguments were made in the UK, and scientific arguments were expressed in NZ, although the latter with less political acumen), our findings suggest that place is primarily important because it determines the cognitive legitimacy and weight accorded to different logics amongst publics and decision-makers.

A further implication of the paper is that it is important to recognise that the political contestation of climate change continues well beyond the legislative adoption stage. A highly charged post-decisional politics was apparent in both NZ and the UK. In NZ, the NZ-ETS can be interpreted as symbolic policy, designed to signal NZ's commitment to international action on climate change. This has meant political resolve for comprehensive "all-sectors, all-gases" implementation has proven weak in the face of a narrative which portrayed clear-cut, negative economic consequences of extending the NZ-ETS to agriculture (Bullock, 2012). In the UK, the CCA was enacted on the back of an optimistic wave of consensus politics (Carter, 2014), with the legislation leaving many of the difficult decisions regarding how to achieve the constituent targets to future governments. The ensuing economic recession, combined with latent opposition to climate change policy amongst influential members of the Conservative party of the ruling Coalition, created a space for arguments predicated on scientific uncertainty. These, in turn, have created an instrumental rationale to downgrade commitment to resourcing and implementing the CCA.

In identifying these post-decisional logics of inaction, we conclude that scholars (and applied policy analysts) need to be more attentive to what happens when climate policies are put into effect. In other words, the passing of legislative action may prove a misleading indicator of actual commitment to, and subsequent action on, climate mitigation.

6.9 Notes

1. This paper uses "sceptical voice" (Painter, 2011; Howarth and Sharman, 2015) in an effort to move away from the problematic labelling constructs evident in the climate debate. The emphasis on the idea of a "voice" re-focuses on the human (the "who" someone is, rather than the "what") whilst also recognising the need for a pragmatic descriptor.

2. NZ-ETS agriculture participants have been required to report on-farm biological emissions since 2012 but are not required to surrender emissions units. The Government has stated that such an obligation will only occur if 'there are economically viable and practical technologies available to reduce emissions' and if NZ's 'trading partners make more progress on tackling their emissions in general' (NZ Government, 2015a).

3. Identified from sources such as Sharman's (2014) list of climate sceptical blog authors and Painter's 'list of sceptics 'mentioned' more than once in 10 UK national newspapers' (2011: 128).

4. Climategate refers to the unauthorised release of over 1,000 emails and documents from the University of East Anglia in 2009.

6.10 References

Anderegg WRL and Goldsmith GR. (2014) Public interest in climate change over the past decade and the effects of the 'climategate' media event. *Environmental Research Letters* 9: 054005.

Associated Press. (2012) *Kyoto 'outdated, insufficient': Groser.* Available at: http://www.stuff.co.nz/national/politics/8027288/Kyoto-outdated-insufficient-Groser.

Bache I, Reardon L, Bartle I, et al. (2014) Symbolic meta-policy: (Not) tackling climate change in the transport sector. *Political Studies* 63: 830-851.

Bardach E. (1977) *The implementation game: What happens after a bill becomes a law,* Cambridge, MA: MIT Press.

Barry A and King-Jones A. (2014) Hot Air (documentary film). New Zealand.

Bartram G and Terry S. (2010) *The carbon challenge: New Zealand's emissions trading scheme,* Wellington: Bridget Williams Books Ltd.

Bassi S and Zenghelis D. (2014) Burden or opportunity? How UK emissions reductions policies affect the competitiveness of businesses. Centre for Climate Change Economics and Policy, and Grantham Research Institute on Climate Change and the Environment Policy Paper. London.

Bazeley P and Jackson K. (2013) *Qualitative data analysis with NVivo,* London: Sage.

Beck U. (1992) *Risk society: Towards a new modernity,* London: Sage.

Binderkrantz AS and Kroyer S. (2012) Customizing strategy: Policy goals and interest group strategies. *Interest Groups & Advocacy* 1: 115-138.

Blühdorn I. (2013) The governance of unsustainability: Ecology and democracy after the post-democratic turn. *Environmental Politics* 22: 16-36.

Boykoff MT. (2007) Flogging a dead norm? Newspaper coverage of anthropogenic climate change in the United States and United Kingdom from 2003 to 2006. *Area* 39: 470-481.

Bullock D. (2012) Emissions trading in New Zealand: Development, challenges and design. *Environmental Politics* 21: 657-675.

Capstick S and Pidgeon N. (2013) What *is* climate change scepticism? Examination of the concept using a mixed methods study of the UK public. *Global Environmental Change* 24: 389-401.

Carter N. (2014) The politics of climate change in the UK. *Wiley Interdisciplinary Reviews: Climate Change* 5: 423-433.

Carter N and Clements B. (2015) From 'greenest government ever' to 'get rid of all the green crap': David Cameron, the Conservatives and the environment. *British Politics* 10: 204-225.

CCC. (2015) *Urgent action needed now to avoid increasing costs and impacts of climate change in the UK.* Available at: http://www.theccc.org.uk/2015/06/30/urgent-action-needed-now-to-avoid-increasing-costs-and-impacts-of-climate-change-in-the-uk/.

Cook J, Nuccitelli D, Green SA, et al. (2013) Quantifying the consensus on anthropogenic global warming in the scientific literature. *Environmental Research Letters* 8: 024024.

Cooper MH and Rosin C. (2014) Absolving the sins of emission: The politics of regulating agricultural greenhouse gas emissions in New Zealand. *Journal of Rural Studies* 36: 391-400.

De Bruycker I. (2014) How interest groups develop their lobbying strategies: The logic of endogeneity, European Consortium for Political Research Annual Conference. Glasgow.

DECC. (2015) 2013 UK greenhouse gas emissions, final figures. London: Department of Energy and Climate Change.

Demeritt D. (2000) The new social contract for science: Accountability, relevance, and value in US and UK science and research policy *Antipode* 32: 308-329.

Demeritt D. (2001) The construction of global warming and the politics of science. *Annals of the Association of American Geographers* 91: 307-337.

Demeritt D. (2006) Science studies, climate change and the prospects for constructivist critique. *Economy and Society* 35: 453-479.

Dimitrakopoulos DG. (2001) The transposition of EU law: 'Post-decisional politics' and institutional autonomy. *European Law Journal* 7: 442-458.

Doyle J. (2015) Green targets 'cost £214 a year': Report says rush for renewable energy has been 'most expensive policy disaster in modern British history'. *The Daily Mail.* 18 March 2015. London: Associated Newspapers Ltd.

Forsyth T. (2012) Politicizing environmental science does not mean denying climate science nor endorsing it without question. *Global Environmental Politics* 12: 18-23.

Fudge S and Peters M. (2011) Behaviour change in the UK climate debate: An assessment of responsibility, agency and political dimensions. *Sustainability* 3: 789-808.

Gluckman P. (2013) The role of evidence in policy formation and implementation: A report from the Prime Minister's Chief Science Advisor. Wellington: Office of the Prime Minister's Science Advisory Committee.

Goodwin M. (2015) Political science? Does scientific training predict UK MPs voting behaviour? *Parliamentary Affairs* 68: 371-392.

Grolin J. (1998) Corporate legitimacy in risk society: The case of Brent Spar. *Business Strategy and the Environment* 7: 213-222.

Groser T. (2012) New Zealand commits to UN Framework Convention. Wellington: New Zealand Government, Available at: http://beehive.govt.nz/release/new-zealand-commits-un-framework-convention.

Grundmann R. (2007) Climate change and knowledge politics. *Environmental Politics* 16: 414-432.

Grundmann R. (2012) The legacy of climategate: Revitalizing or undermining climate science and policy? *Wiley Interdisciplinary Reviews: Climate Change* 3: 281-288.

Grundmann R and Scott M. (2014) Disputed climate science in the media: Do countries matter? *Public Understanding of Science* 23: 220-235.

Guber DL. (2013) A cooling climate for change? Party polarization and the politics of global warming. *American Behavioral Scientist* 57: 93-115.

Hannigan J. (2014) *Environmental sociology,* London: Routledge.

Hess DJ. (2014) When green became blue: Epistemic rift and the corralling of climate science. *Political Power and Social Theory* 27: 123-153.

Hoffman A. (2011) Talking past each other? Cultural framing of skeptical and convinced logics in the climate change debate. *Organization & Environment* 24: 3-33.

Hoffman A. (2015) *How culture shapes the climate change debate,* Stanford, CA: Stanford University Press.

Holmes J and Clark R. (2008) Enhancing the use of science in environmental policy-making and regulation. *Environmental Science & Policy* 11: 702-711.

Howarth C and Sharman A. (2015) Labeling opinions in the climate debate: A critical review. *Wiley Interdisciplinary Reviews: Climate Change* 6: 239-254.

Howlett M. (2012) The lessons of failure: Learning and blame avoidance in public policy-making. *International Political Science Review* 33: 539-555.

Hughey KFD, Kerr GN and Cullen R. (2013) Public perceptions of New Zealand's environment: 2013. Canterbury: Lincoln University.

Hulme M. (2009) *Why we disagree about climate change: Understanding controversy, inaction and opportunity,* Cambridge: Cambridge University Press.

IPCC. (2007) Climate change 2007: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. In: Solomon S, Qin D, Manning M, et al. (eds) *IPCC Fourth Assessment Report.* Cambridge: Cambridge University Press.

Jacques PJ, Dunlap RE and Freeman M. (2008) The organisation of denial: Conservative think tanks and environmental scepticism. *Environmental Politics* 17: 349-385.

Jaspal R, Nerlich B and van Vuuren K. (2015) Embracing and resisting climate identities in the Australian press: Sceptics, scientists and politics. *Public Understanding of Science*, doi: 10.1177/0963662515584287.

Jiang N, Sharp B and Sheng M. (2009) New Zealand's emissions trading scheme. *New Zealand Economic Papers* 43: 69-79.

Kelly G. (2010) Climate change policy: Actions and barriers in New Zealand. *International Journal of Climate Change Impacts and Responses* 2: 277-290.

Lalor BM and Hickey GM. (2014) Strengthening the role of science in the environmental decision-making processes of executive government. *Organization & Environment* 27: 161-180.

Layzer JA. (2007) Deep freeze: How business has shaped the global warming debate in Congress. In: Kraft ME and Kamieniecki S (eds) *Business and environmental policy: Corporate interests in the American political system.* Cambridge, MA: MIT Press, 93-126.

Leiserowitz A, Maibach EW, Roser-Renouf C, et al. (2013) Climategate, public opinion, and the loss of trust. *American Behavioral Scientist* 57: 818-837.

Lipsky M. (1979) *Street level bureaucracy: Dilemmas of the individual in public services,* New York: Russell Sage Foundation.

Lodge M and Matus K. (2014) Science, badgers, politics: Advocacy coalitions and policy change in bovine tuberculosis policy in Britain. *Policy Studies Journal* 42: 367-390.

Macalister T. (2014) Ed Davey attacks coalition partners over pledge to end wind subsidies. *The Guardian*. 22 October 2014. London: Guardian News and Media Ltd.

Mahony M. (2014) The IPCC and the geographies of credibility. *History of Meteorology* 6: 95-112.

Marris C, Joly P-B, Ronda S, et al. (2005) How the French GM controversy led to the reciprocal emancipation of scientific expertise and policy making. *Science and Public Policy* 32: 301-308.

Mason E. (2013) The New Zealand Emissions Trading Scheme: What has gone wrong and what might we achieve? *New Zealand Journal of Forestry* 58: 30-34.

McCright AM and Dunlap RE. (2003) Defeating Kyoto: The conservative movement's impact on U.S. climate change policy. *Social Problems* 50: 348-373.

McCright AM and Dunlap RE. (2010) Anti-reflexivity: The American conservative movement's success in undermining climate science and policy. *Theory Culture & Society* 27: 100-133.

MFE. (2014) New Zealand's greenhouse gas inventory & net position report 1990-2012. Wellington: Ministry for the Environment.

MFE. (2015a) New Zealand's Greenhouse Gas Inventory 1990-2013. Wellington: Ministry for the Environment.

MFE. (2015b) *New Zealand's post-2020 climate change target*. Available at: http://www.mfe.govt.nz/node/20725/.

Michaels D. (2008) *Doubt is their product: How industry's assault on science threatens your health,* Oxford: Oxford University Press.

Milbrath LW. (1960) Lobbying as a communication process. *The Public Opinion Quarterly* 24: 32-53.

Miller G and Blackham M. (2014) Careers of the members of the New Zealand Parliament (2014). Wellington: Blackland PR.

Nachmany M, Fankhauser S, Davidova J, et al. (2015) *2015 global climate legislation study,* London: Grantham Research Institute on Climate Change and the Environment.

Naylor R, Maye D, Ilbery B, et al. (2014) Researching controversial and sensitive issues: Using visual vignettes to explore farmers' attitudes towards the control of bovine tuberculosis in England. *Area* 46: 285-293.

Nerlich B. (2010) 'Climategate': Paradoxical metaphors and political paralysis. *Environmental Values* 19: 419-442.

Newig J. (2007) Symbolic environmental legislation and societal self-deception. *Environmental Politics* 16: 276-296.

Newman J and Head BW. (2015) Categories of failure in climate change mitigation policy in Australia. *Public Policy and Administration* 30: 342-358.

NZ Government. (2015a) *Climate change information New Zealand*. Available at: http://climatechange.govt.nz/.

NZ Government. (2015b) New Zealand economic and financial overview 2015. Wellington: The Treasury.

NZCSC. (2010) High Court asked to invalidate NIWA's official NZ temperature record. Auckland: NZCSC. Available at http://nzclimatescience.net/images/PDFs/niwa.ct.docs.pdf.

Oreskes N and Conway EM. (2010) *Merchants of doubt: How a handful of scientists obsured the truth on issues from tobacco smoke to global warming,* New York: Bloomsbury Press.

Page E and Jenkins WI. (2005) *Policy bureaucracy: Government with a cast of thousands,* Oxford: Oxford University Press.

Painter J. (2011) *Poles apart: The international reporting of climate scepticism,* Oxford: University of Oxford.

Paterson O. (2014) *2014 Annual GWPF Lecture - Owen Paterson: Keeping the lights on*. Available at: http://www.thegwpf.org/2014-annual-gwpf-lecture-owen-paterson-keeping-the-lights-on/.

Puchala DJ. (1975) Domestic politics and regional harmonization in the European Communities. *World Politics* 27: 496-520.

Ryan D. (2015) From commitment to action: A literature review on climate policy implementation at city level. *Climatic Change* 131: 519-529.

Ryghaug M. (2011) Obstacles to sustainable development: The destabilization of climate change knowledge. *Sustainable Development* 19: 157-166.

Scoones I. (2008) Mobilizing against GM crops in India, South Africa and Brazil. *Journal of Agrarian Change* 8: 315-344.

Sharman A. (2014) Mapping the climate sceptical blogosphere. *Global Environmental Change* 26: 159-170.

Sharman A and Holmes J. (2010) Evidence-based policy or policy-based evidence gathering? Biofuels, the EU and the 10% target. *Environmental Policy and Governance* 20: 309-321.

Skodvin T, Gullberg AT and Aakre S. (2010) Target-group influence and political feasibility: The case of climate policy design in Europe. *Journal of European Public Policy* 17: 854-873.

Suhay E and Druckman JN. (2015) The politics of science: Political values and the production, communication, and reception of scientific knowledge. *The ANNALS of the American Academy of Political and Social Science* 658: 6-15.

Swyngedouw E. (2010) Apocalypse forever? Post-political populism and the spectre of climate change. *Theory, Culture & Society* 27: 213-232.

TVNZ. (2014) Catastrophic global warming predictions rubbished. *Breakfast*. Auckland: TVNZ.

Van Rensburg W. (2015) Climate change scepticism: A conceptual re-evaluation. *SAGE Open* 5.

Vining AR, Shapiro DM and Borges B. (2005) Building the firm's political (lobbying) strategy. *Journal of Public Affairs* 5: 150-175.

Viola E and Franchini M. (2014) Brazilian climate politics 2005–2012: Ambivalence and paradox. *Wiley Interdisciplinary Reviews: Climate Change* 5: 677-688.

Vogel D. (2012) *The politics of precaution: Regulating health, safety, and environmental risks in Europe and the United States,* Princeton: Princeton University Press.

Wesselink A, Buchanan KS, Georgiadou Y, et al. (2013) Technical knowledge, discursive spaces and politics at the science–policy interface. *Environmental Science & Policy* 30: 1-9.

Whatmore SJ. (2009) Mapping knowledge controversies: Science, democracy and the redistribution of expertise. *Progress in Human Geography* 33: 587-598.

Whitmarsh L. (2009) Behavioural responses to climate change: Asymmetry of intentions and impacts. *Journal of Environmental Psychology* 29: 13-23.

Chapter 7. Conclusion

7.1 Introduction

Debate about climate change offers countless possibilities for investigation and examination. Building on an initial curiosity regarding how decisions are made about climate change within the context of contentious public debate, and drawing from the literature examining public scientific controversies (Engelhart and Caplan, 1987; Martin and Richards, 1995; Pinch, 2001), this thesis has come to conceptualise climate change as, fundamentally, a controversy about knowledge. In so doing, it has attempted to make explicit the underlying 'politics of knowledge' (Beck, 1992: 51; see also Grundmann and Stehr, 2003; Grundmann, 2007; Grundmann, 2013) that are at play within the climate change debate. Knowledge has been a central topic of concern within the social science literature, particularly within the STS and SSK traditions for many years (Pinch and Bijker, 1984; Jasanoff, 1987; Gibbons et al., 1994; Barnes et al., 1996). It has also been recognised as a critically important component of controversial public debates involving science, as claims and counter-claims are assembled in order to influence scientific conclusions and policy decision-making (Martin and Richards, 1995; van Eeten, 1999; Sarewitz, 2004; Young and Matthews, 2007; Wynn and Walsh, 2013; Naylor et al., 2014). Climate change provides an excellent lens with which to examine knowledge controversy due to its nature as an issue of unprecedented complexity and "wickedness" (Rittel and Webber, 1973). It is also globally politically relevant and encapsulates much that is debated within the literature on science studies, such as expertise, opinion formation, and values.

However, despite substantial consideration of the communication and psychology of doubt about climate change (Stoll-Kleemann et al., 2001; Boykoff, 2007; Boykoff and Mansfield, 2008; Huntingford and Fowler, 2008; Anderson, 2009; Akerlof et al., 2012; Painter and Ashe, 2012; Spence et al., 2012; Boykoff, 2013; Schmidt et al., 2013; Grundmann and Scott, 2014; Clayton et al., 2015), there has been a lack of attention within the literature to understanding conflict over climate change at the 'individual and organizational levels of analysis' (Hoffman, 2011: 5). This research has therefore combined existing theoretical conceptions of knowledge and public scientific controversies with a detailed examination of the specific form, value and impact of controversy over climate change. Five separate research questions were identified under two sub-topics, all of which contributed towards achieving the overarching aim

of investigating climate change as a knowledge controversy. Each question formed a guiding framework for an individual research paper (Table 7.1). This section, Part 4 of the thesis, draws together these five papers and, with reference to the literature in which this research is situated, presents the main findings of this thesis as a whole. It begins with a discussion of each sub-topic, before identifying cross-cutting conclusions which reflect on the topics of knowledge, controversy, science and policy more broadly.

Table 7.1: Sub-topics, research questions and individual papers of this thesis

Sub-topic	Research question	Chapter and title of individual research paper
The relationship between the form of the climate change debate and the value placed on particular knowledge claims (Part 2 of this thesis)	Where is knowledge contested?	2. Mapping the climate sceptical blogosphere
	How does the framing of the climate change debate contribute towards knowledge contestation?	3. Labelling opinions in the climate debate: A critical review
	How does the valuing of knowledge claims contribute towards rationales for debate participation?	4. Climate stories: Why do climate scientists and sceptical voices participate in the climate debate?
The impact of knowledge contestation (Part 3 of this thesis)	How does knowledge controversy impact the production of scientific knowledge?	5. The impact of controversy on the production of scientific knowledge
	How does knowledge controversy impact policy decision-making?	6. Post-decisional logics of inaction: The impact of climate controversy on policy decision-making

7.2 Summary and discussion of main findings

7.2.1 The form and value of knowledge contestation

The first three individual research papers (comprising Part 2 of this thesis) aimed to investigate the relationship between the form of the climate change debate and the value placed on particular knowledge claims. Understanding where controversy exists and how it is framed allows for an appreciation of how different types of arguments and rationales become resonant and valued within controversial situations. Moreover, whilst offering insights in and of themselves, these papers also provided an important foundation for the research investigating the impact of knowledge contestation in Part 3 of this thesis.

The first individual research paper, Chapter 2: *Mapping the climate sceptical blogosphere*, examined the location of knowledge contestation in the climate change debate. Specifically, it was motivated by the observation that much of the contestation

about climate change either appeared to originate from, or be actively discussed within, the online environment (Schäfer, 2012); however, that very little was known about its composition or why such environments appeared to occupy such positions of importance within the climate change debate. Despite suggestions that online environments can take the form of self-referential and polarising "echo chambers" (Edwards, 2013; Williams et al., 2015), other research has indicated that they may be playing an increasingly important role in public debate, particularly in controversial situations (Farrell and Drezner, 2008; Hsu and Lin, 2008). This research therefore addressed an important gap in the literature by identifying both the climate sceptical blogosphere itself (a network of 171 blogs) and via social network analysis, its three most central sites. However, in addition to identifying the form of a previously unknown (to the academic literature) location of knowledge contestation within the context of climate change, it also uncovered another more critical and pertinent finding as regards knowledge contestation, namely that the blogs identified as the most central focused on the scientific element of the climate change debate. This scientifically-focused framing encompassed either direct challenges to mainstream climate science or critiques of the conduct of the actors or institutions involved within the science system. The conclusion that the climate sceptical blogosphere remains preoccupied with framing climate change as an active scientific controversy is important because it highlights the critical role of knowledge and expertise in perpetuating controversy in different spatial locations. Despite the increasing accessibility to and dispersed nature of knowledge in contemporary society (Gibbons et al., 1994; Stehr, 1994; Castells, 2000; Nowotny et al., 2003), this research directly contributes to the literature on controversies by arguing that the ability to wield cognitive authority in a contested domain not only remains highly valued but that it is also strongly topic and context-dependent. In the climate sceptical blogosphere, value is placed on commanding *scientific* information, and critiquing *scientific* practice and process. Legitimacy is thus influenced by knowledge regarding the practice of science, rather than needing to be underpinned by formal markers of authority valued within mainstream knowledge networks such as qualifications or professional appointments.

The second and third papers, Chapter 3: *Labelling opinions in the climate debate: A critical review* and Chapter 4: *Climate stories: Why do climate scientists and sceptical voices participate in the climate debate?*, were jointly motivated by a desire to understand the antagonism and polarisation evident within the climate change debate, clearly visible during the research carried out for Chapter 2. While hostility is not

unsurprising in cases of public scientific controversy, what appeared however to be particularly distinct and noteworthy about the case of climate change was the dramatically polarised nature of the discussion, with the debate played out in the public domain as two distinct and separate camps at opposing ends of a spectrum. Drawing inspiration from the rhetorical elements of frame analysis (Goffman, 1974), Chapter 3 addressed an important gap in the literature by providing a comprehensive analysis of the labels employed within the climate debate such as "denier" or "alarmist". It examined how such labelling constructs were employed and understood within the academic literature and argued that the focus on typologies was diverting attention away from understanding the underlying motivations and rationales evident within the climate change debate. In addition to a critical review of the literature, it also identified a number of problematic issues with the use of labels in the context of climate change, such as how their binary format at opposing ends of a hostile spectrum may be serving to exacerbate polarisation and group identity formation. These findings are directly relevant to the notion of knowledge controversy because they highlight how rhetorical strategies may influence the very nature of the debate itself. Labelling constructs prioritise *who* one is (with all the surrounding connotations and assumptions which are linked to that label) rather than necessarily *what* is being argued or *why* that position is held. The value of knowledge claims thus becomes inextricably linked to the messenger, with labels serving to isolate and exclude claims-makers from constructive dialogue due to the category label to which they have been assigned (Canales, 2000; Jacques, 2012). This research provides an important theoretical contribution to the thesis, particularly in terms of the links made between science studies and theories within psychology, sociology and geography. Critically, it also argues that a lack of attention has been paid to the contextual aspects of labels, resulting in an inadequate appreciation of the power present in these discursive terms in different spatial environments.

Chapter 4 built on the need identified at the end of Chapter 3 for further research into the underlying motivations and rationales behind climate change opinions. Specifically, it addressed the rationales behind different actors' involvement in the climate change debate in order to understand how the valuing of different knowledge claims may contribute towards debate participation. Based on 22 interviews with climate scientists and sceptical voices about climate change it addressed two important gaps in the literature: *why* key participants become drawn into, or choose to become involved in, contentious public scientific controversies, and *how* the paradigms in which they

operate may contribute towards the antagonistic nature of the debate itself. These actors are differentiated from the general public by their status as holders of relevant expertise (be this self-designated or otherwise), with the allocation of expertise deemed critical as a way to legitimise actors' cognitive authority within contested domains. This research showed however that it is not solely due to different interpretations of knowledge, or even an explicit desire to see their own evidence prevail, that alone causes debate participation. Instead it found a more nuanced and complex picture whereby multiple factors in addition to the "politics of knowledge", including moral rationales, together influence debate participation. These include a sense of duty, equity, and a heroic desire to be of use to society. In addition to identifying multiple factors influencing debate participation, this research provides a valuable contribution to the literature by highlighting the potential misalignment of actors and their roles in engaging in public debate over climate change and the opportunity for a renegotiation of the actor-subject interaction in public discourse. Importantly, it also argues that critical self-reflexivity and a focus on overlaps between both manifest and latent rationales for debate participation may be valuable mechanisms to reduce polarisation and antagonism in the climate debate.

7.2.2   The impact of knowledge controversy

The third part of this thesis examined the impact of knowledge controversy within the context of climate change, with Chapter 5: *The impact of controversy on the production of scientific knowledge*, focusing on the impact on the production of scientific knowledge and Chapter 6: *Post-decisional logics of inaction: The impact of climate controversy on policy decision-making*, examining the impact on policy decision-making. The key motivation behind these chapters was that while much of the literature addressing controversy about climate change has focused on describing arguments or investigating how such arguments are communicated via the media, a critical gap remained in terms of understanding whether, and if so, how, such controversy actually matters. Chapter 5 was specifically inspired by the observation that whereas many, mostly anecdotal accounts of scientific controversy were available, little rigorous empirical research had been carried out to understand how knowledge controversy may concretely influence science itself. Interviews were conducted with 63 climate scientists, academics working in related social science fields, and sceptical voices, and initially focused on identifying impact on the practice of science. The research found that whereas the majority did not identify impact on scientific practice

(the "doing" of science), the vast majority did identify impacts, such as increased caution or disruption, on the more expansive notion of scientific agency (defined essentially as the ability of actors to carry out the practice of science). The puzzle of this finding was thus not so much about explaining the types of impacts identified (despite recognising the contribution of this research in terms of identifying these influences on scientific agency), but how scientists were able to so clearly differentiate between impacts on agency and practice. Gieryn's (1983; 1999) theory of boundary work was employed to explain this conundrum, with the paper arguing that scientists' ability to distinguish between these two types of impact can be seen as a performative process aimed at maintaining the epistemic authority of science as a distinct form of knowledge production. The key theoretical contribution made in this research is the identification of an important relationship between controversy and boundary work, specifically that the greater the impact of controversy (as perceived by scientists), the less fluid and contingent the boundary between scientific agency and practice. The paper also directly contributes towards an extension of the concept of boundary work by arguing that it is a more active and explicit process under conditions of controversy as scientists protect their cognitive authority. In making these conclusions it links theoretical conceptions of scientific practice and agency with existing literature on scientific controversy to provide new insights into scientific behaviours and also emphasises the importance of boundary work as a theoretical lens within science studies. Chapter 5 also commented on the implications of the findings regarding impact, such as increased caution, for epistemological norms and the social value of science.

Finally, Chapter 6 used the full corpus of 99 research interviews carried out for this thesis with politicians, policy officials, climate scientists, academics, and others to investigate the impact of knowledge controversy on policy decision-making. Noting that an important gap in the literature existed regarding the post-decisional politics influencing climate policy decision-making, this paper identifies the motivational logics undermining the implementation of climate policy, or which are used by decision-makers to justify inaction. It provides three key contributions to knowledge, the first of which is identifying how knowledge controversy about climate change impacts public policy decision-making during the implementation phase. The second is the provision of new insights into the way that knowledge controversies play out across space. Finally, the third is the identification of context-specific post-decisional logics of inaction which influence the effectiveness of existing climate change policies. In the

first case study, NZ, the research identified an overwhelmingly dominant post-decisional logic of inaction of the current national economic interest, whereas in the second case study, the UK, arguments based on notions of scientific doubt were found to be a more important influence on policy decision-making. This research highlights the strongly post-decisional nature of climate change policy-making and emphasises the importance of being attentive to knowledge controversy even after policies have been enacted. Critically, the finding that the impact of controversy is different in different locations emphasises the importance of being aware of the temporal and spatial nuances that come into play once policies are implemented.

7.2.3   Cross-cutting conclusions and reflections

While each individual paper comprising this thesis makes distinct individual conclusions and contributions to the literature, some cross-cutting conclusions and reflections are also possible. This section identifies four main conclusions arising from an integrated analysis of the research contained within this thesis.

The first cross-cutting conclusion refers to the overarching conceptual framework of this research and contends that **knowledge controversy is a defining feature of the climate change debate**. This may seem like an obvious conclusion given the vast literature examining various facets of the claims and counter-claims inherent in disputes over climate change, much of which has been referenced throughout this thesis (Martin and Richards, 1995; Nowotny et al., 2001; Sarewitz, 2004; Berkhout, 2010; Jankó et al., 2014), but the explicit conceptualisation of climate change as, fundamentally, a knowledge controversy is an important distinction to make. While this research has shown that in certain cases, knowledge contestation may not necessarily be the dominant rationale behind climate change decision-making and opinion formation, such as the current national economic interest logic of inaction dominant in NZ shown in Chapter 6, or some of the more values-based rationales behind the opinions described in Chapter 4; reflecting on the content of this thesis as a whole, knowledge, and specifically, contestation over knowledge, is a fundamental connective theme. More often than not, disputes over, or value accorded to, particular knowledge claims, as well as contestation regarding the authority and influence conferred to holders of such claims have been found to be core, underlying characteristics of the climate change debate. For example, in Chapter 2, the ability to command a certain type of knowledge was shown to be an influential factor in

determining the centrality of blogs within the climate sceptical blogosphere, and in Chapter 3, how particular individuals were labelled was argued to be a significant contributory factor to how knowledge claims come to be subsequently valued within the climate change debate. In Chapter 5, knowledge controversy was shown to have important impacts on the agency of climate scientists and in Chapter 6, knowledge controversy invoking scientific doubt was found to be a dominant feature of the UK climate change policymaking environment. In coming to this conclusion, the intent is not to downplay the importance of values or worldviews as integral elements of disputes over climate change (Hulme, 2009; Corner et al., 2015; Suhay and Druckman, 2015), particularly given the recognised interplay between values and assessment of knowledge claims shown by authors such as Kahan et al. (2011), Douglas (2009) and others. Rather the purpose is to direct critical attention towards the myriad ways in which knowledge claims are assembled within the climate change debate, as well as their potentially significant influence on processes of science and policy.

The next two conclusions are related by their focus on the spatial nature of knowledge controversy. The second cross-cutting conclusion is that **there is a relationship between the location of knowledge contestation and the dominant framing of knowledge claims, arguments and rationales**. While focused on the form/value and impact of knowledge contestation respectively, both Chapter 2 and 6 found that in certain locations and contexts, scientifically-framed arguments were more prevalent and were thus argued to hold greater cognitive authority than those related to political factors. In Chapter 2 the emphasis placed on scientific knowledge was found to be related to the central blogs' success in positioning themselves as gatekeepers and interpreters in an alternative knowledge network running parallel to the mainstream academic environment. In Chapter 6, scientifically-based arguments were clearly seen to be influencing post-decisional logics of inaction in the UK policymaking environment (and were also shown in the rationales underlying debate participation by UK-based individuals in Chapter 4), but were not seen to be playing an important role in the NZ context. This conclusion—that different framings of knowledge have different values in different contexts—highlights the importance of paying attention to the micro-components of a controversy and suggests that extrapolating conclusions across geographic locations is unwise without understanding place-specific nuance. Furthermore, despite suggestions that robust support exists for comprehensive climate change policy at the national level (Bernauer and Gampfer, 2015), this research also shows that scientifically-based disagreement is still an influential framing in certain

contexts. This conclusion supports arguments within the existing literature that the ability to make authoritative scientific knowledge claims is a critical element of knowledge controversies due to their ability to convey legitimacy and influence (Jasanoff, 1987; Martin and Richards, 1995; Demeritt, 2006; Gulbrandsen, 2008; Grundmann, 2009; Suryanarayanan and Kleinman, 2013; Collins, 2014), but it also suggests that the climate change debate is likely to include some form of scientifically-based dispute for the foreseeable future. While arguments and strategies may shift according to the perception of certainty on particular topics—which also highlights interesting questions regarding the making of authoritative knowledge (Hampel, 2014)—the complexity of climate change, particularly as regards comprehensive understanding of the relationships between systemic cause and effect, means contestation over scientific knowledge claims are unlikely to fully disappear in this context.

The third conclusion is that **impacts of knowledge controversy are context-specific and place-based**. Chapters 5 and 6 show that whereas in NZ knowledge controversy does not influence policy decision-making or scientific practice, it is influencing scientific agency. Conversely, in the UK, knowledge controversy is influencing both policy decision-making and scientific agency, albeit in different ways. Place is critical to consider as the impact of knowledge controversy is shown as markedly distinct in the two case study locations, particularly in terms of policy decision-making. This research has therefore shown that the specific impact of knowledge controversy is strongly tempered by both national context and what the anticipated implications of such impact may be, i.e. admitting to being influenced by controversy can also be seen as an active decision which has implications for perceived cognitive authority.

In making the above conclusions, this thesis clearly situates itself not just as immersed in STS and SSK, but also as a geographical text. Being aware of the relevance of spatiality is important because it enables the research contained within this thesis to contribute to the ongoing 'conversations between geography and science and technology studies' (Whatmore, 2009: 587) on the topic of knowledge controversy. It also means that it follows in the footsteps of a small but vibrant strain of scholarship examining the spatial nature of knowledge controversies, including by Livingstone (2003), Powell (2007) and Mahony (2014a; 2014b). It advances this body of work through the identification of differentiated impact on scientific practice and agency, and the concept of post-decisional logics of inaction. It also emphasises the importance

of understanding the role of framing as a communication and analytical device within knowledge controversies.

Finally, the fourth cross-cutting conclusion is that **performative processes are critical elements of knowledge controversies**. Chapter 3 clearly shows that the language used in controversial situations can be understood as performative—antagonism and polarisation are co-constructed by rhetorical choices—thus contributing towards a new angle on knowledge controversies that brings together rhetorical understandings with existing work within science studies (Ceccarelli, 2011). Language and framing are therefore clearly shown to be critical factors influencing knowledge controversies. Taken together with Chapter 2, Chapter 4 also highlights an important point regarding the way in in which actors involved in a controversy choose to express their arguments and rationales. Whereas underlying worldviews and values are critically important (Hulme, 2009), the explicit framings made by actors within controversial situations are also worth identifying as they can reflect the value that individuals place on particular elements within a debate—even if it is a purely instrumental framing intended to gain influence or authority (Grundmann, 2007). Finally, Chapter 5 explains the ability of scientists to distinguish between impacts on scientific agency and practice as a performative boundary-making process. The key finding that boundary work is more active and explicit under conditions of controversy is particularly important because it can also be understood as a strategic defence mechanism for the retention of cognitive authority. The engagement in boundary work of those operating within a dominant paradigm is thus likely to have implications not only for the continued influence of particular epistemic paradigms, but also for the way in which expertise (both internal and external to the dominant paradigm) is valued. This research therefore also contributes to wider understandings of the extension of expertise, such as those concerning post-normal science (Funtowicz and Ravetz, 1993; Ravetz, 2011; Ravetz, 2012; Turnpenny, 2012; Bernstein et al., 2014), as well as supporting arguments that contend that defining questions of interest and associated experts/ise is a 'value laden and political act' (Demeritt, 2006: 467). As indicated above, it also reaffirms the notion of controversy as an excellent framework with which to examine the making and unmaking of authoritative scientific knowledge (Hampel, 2014).

7.3   Limitations and further research

While this thesis makes a number of contributions towards increasing understanding of knowledge controversies, as with any research project, limitations exist which are suggested to form the basis of future enquiry. First, a clear extension of this research would be to undertake a larger-scale survey in order to test the wider representativeness of the results contained within, particularly, Chapters 5 and 6. While every effort was made to reach message saturation during the interview process, it is possible that a different sub-section of views may not have been captured. In addition to verifying conclusions and identifying further themes or opinions, a larger survey may be useful in providing participants with a greater degree of confidence in the anonymity of their responses. Encouraging candour, particularly when interviewees are discussing details of practices within their current workplaces, or when interviewees are in positions of power, is challenging despite guarantees of anonymity (Pelz, 1959; Welch et al., 2002). Nonetheless, given the complexity of this research topic, and especially the way in which critical self-reflexivity was able to be investigated during the in-depth in-person interview process, a survey may necessarily be regarded as a complementary, rather than standalone research method in this context.

Second, it would have been desirable to conduct more than one interview with each research participant. This is useful in order to validate the interpretations made during the analysis phase of the research, as well as to capture any additional reflections from participants post-interview (Baxter and Eyles, 1997), particularly given the long duration between the beginning of the interview process (November 2012) and the submission of this thesis (September 2015). While all interviewees were encouraged to continue contact via email, and some did send additional thoughts, larger scale revisits were impossible due to time and resource constraints. Follow-up research involving further interviews or verification of findings via alternative methods would also benefit from the increased technical and theoretical knowledge gained as part of this research process.

Third, as explained in Chapter 1, this thesis is based on the premise put forward by Painter (2011) that controversy about climate change may be largely understood as an Anglo-Saxon phenomenon. Accordingly, research was carried out predominantly in NZ and the UK (excluding the blog-based research in Chapter 2). Especially given the conclusion that impacts of knowledge controversy are context and place-specific, it is

therefore expected that many of the findings contained within this thesis would likely be different had alternative case study locations been chosen. However, this does not diminish the value of the conclusions of this work. For example, the concept of post-decisional logics of inaction presented in Chapter 6 is universally applicable and provides a rich vein of potential further research, especially due to the nature of such logics as inherently place-based and context-dependent.

Finally, a number of other research directions are possible based on the large amount of data collected as part of the interviews carried out in NZ and the UK. First, despite policy officials having long been recognised as forming an integral part of the decision-making environment within particular political systems (Ham and Hill, 1984; Kingdon, 1995) there is a notable gap within the literature in terms of providing first-hand accounts of policy officials' experiences, particularly in the context of knowledge controversies. The dataset created during this research project of 27 interviews with policy officials involved with climate change policymaking provides important insights into this process and is suitable for further analysis. Second, a substantial amount of data was collected regarding the topic of expertise; specifically how individuals practically determine the legitimacy of knowledge as a basis upon which to form opinions and make decisions. Future research analysing such assessments under conditions of controversy (for example, which specific conventions and markers of expertise are deemed appropriate) is thus a possible line of enquiry. Third, many of the interviewees directly suggested that blogs played an important role as regards influencing policy decision-making processes. Therefore an extension to the research contained within Chapter 2 could employ this information to further analyse their influence beyond the online environment. This could be combined with process tracing (Collier, 2011) to determine the influence of arguments either emerging from or dominant within online environments to other forms of media which currently dominate public science communication channels such as television (Horrigan, 2006; Eurosurveillance Editorial Team, 2013; Castell et al., 2014).

7.4 Conclusion

The overarching aim of this thesis was to investigate climate change as a knowledge controversy. In so doing, it has emphasised the value of being attentive to geography and context, arguing that a relationship between the location of knowledge contestation and the dominant framing of knowledge claims, arguments and rationales

exists, and also that the impacts of knowledge controversy are context and place-specific. It has also contended that performative processes are critical elements of knowledge controversies. It has provided novel methodological contributions to the literature by applying social network analysis to the climate sceptical blogosphere and via the incorporation of sceptical voices within the interview corpus. It has been empirically novel in its examination of the direct impact of knowledge controversy on processes of science and policy in the UK and NZ, and has provided conceptual advancement in the form of extensions to the theory of boundary work and through the introduction of the concept of post-decisional logics of inaction.

Knowledge controversies are an increasingly ubiquitous feature of contemporary society as access to information increases and evidence is assembled to support opposing points of view (Jasanoff, 2004). However, while this thesis has suggested some avenues aimed at diffusing the antagonism inherent within the climate change debate, it does not intend to imply that knowledge controversies themselves are necessarily normatively negative and thus need to be "solved", or that certain types of expertise are more or less "correct". Indeed it seems inevitable that there will always be different interpretations of evidence and associated assessments of relevant policy responses (Kahan et al., 2011; Nisbet, 2011). Instead, this thesis has emphasised the importance of being critically attuned to, and cognisant of, the myriad different ways knowledge shapes contentious situations. This is a fascinating field of scholarship with countless potential future research avenues. It is also deeply practically relevant and it is hoped that the findings of this thesis are of use to those working in public scientific controversies today and in the future.

7.5 References

Akerlof K, Rowan KE, Fitzgerald D, et al. (2012) Communication of climate projections in US media amid politicization of model science. *Nature Climate Change* 2: 648-654.

Anderson A. (2009) Media, politics and climate change: Towards a new research agenda. *Sociology Compass* 3: 166-182.

Barnes B, Bloor D and Henry J. (1996) *Scientific knowledge: A sociological analysis,* London: Athlone.

Baxter J and Eyles J. (1997) Evaluating qualitative research in social geography: Establishing 'rigour' in interview analysis. *Transactions of the Institute of British Geographers* 22: 505-525.

Beck U. (1992) *Risk society: Towards a new modernity,* London: Sage.

Berkhout F. (2010) Reconstructing boundaries and reason in the climate debate. *Global Environmental Change* 20: 565-569.

Bernauer T and Gampfer R. (2015) How robust is public support for unilateral climate policy? *Environmental Science & Policy* 54: 316-330.

Bernstein M, Foley R and Bennett I. (2014) An operationalized post-normal science framework for assisting in the development of complex science policy solutions: The case of nanotechnology governance. *Journal of Nanoparticle Research* 16: 1-14.

Boykoff MT. (2007) From convergence to contention: United States mass media representations of anthropogenic climate change science. *Transactions of the Institute of British Geographers* 32: 477-489.

Boykoff MT. (2013) Public enemy no. 1? Understanding media representations of outlier views on climate change. *American Behavioral Scientist* 57: 796-817.

Boykoff MT and Mansfield M. (2008) 'Ye olde hot aire': Reporting on human contributions to climate change in the UK tabloid press. *Environmental Research Letters* 3: 1-8.

Canales MK. (2000) Othering: Toward an understanding of difference. *Advances in Nursing Science* 22: 16-31.

Castell S, Charlton A, Clemence M, et al. (2014) Public attitudes to science 2014. London: Ipsos MORI.

Castells M. (2000) *The rise of the network society,* Oxford: Blackwell.

Ceccarelli L. (2011) Manufactured scientific controversy: Science, rhetoric, and public debate. *Rhetoric and Public Affairs* 14: 195-228.

Clayton S, Devine-Wright P, Stern PC, et al. (2015) Psychological research and global climate change. *Nature Climate Change* 5: 640-646.

Collier D. (2011) Understanding process tracing. *Political Science and Politics* 44: 823-830.

Collins H. (2014) Rejecting knowledge claims inside and outside science. *Social Studies of Science* 44: 722-735.

Corner A, Roberts O, Chiari S, et al. (2015) How do young people engage with climate change? The role of knowledge, values, message framing, and trusted communicators. *Wiley Interdisciplinary Reviews: Climate Change* 6: 523-534.

Demeritt D. (2006) Science studies, climate change and the prospects for constructivist critique. *Economy and Society* 35: 453-479.

Douglas H. (2009) *Science, policy, and the value-free ideal,* Pittsburgh: University of Pittsburgh Press.

Edwards A. (2013) (How) do participants in online discussion forums create echo chambers? The inclusion and exclusion of dissenting voices in an online forum about climate change. *Journal of Argumentation in Context* 2: 127-150.

Engelhart HT and Caplan AL. (1987) *Scientific controversies: Case studies in the resolution and closure of disputes in science and technology,* Cambridge: Cambridge University Press.

Eurosurveillance Editorial Team. (2013) Special Eurobarometer reveals television as main source of information for developments in science and technology. *Eurosurveillance.* 18: 20646.

Farrell H and Drezner DW. (2008) The power and politics of blogs. *Public Choice* 134: 15-30.

Funtowicz SO and Ravetz JR. (1993) Science for the post-normal age. *Futures* 25: 739-755.

Gibbons M, Limoges C, Nowotny H, et al. (1994) *The new production of knowledge: The dynamics of science and research in contemporary societies,* London: Sage.

Gieryn TF. (1983) Boundary-work and the demarcation of science from non-science: Strains and interests in professional ideologies of scientists. *American Sociological Review* 48: 781-795.

Gieryn TF. (1999) *Cultural boundaries of science: Credibility on the line,* Chicago: University of Chicago Press.

Goffman E. (1974) *Frame analysis: An essay on the organization of the experience,* New York: Harper Colophon.

Grundmann R. (2007) Climate change and knowledge politics. *Environmental Politics* 16: 414-432.

Grundmann R. (2009) The role of expertise in governance processes. *Forest Policy and Economics* 11: 398-403.

Grundmann R. (2013) Debunking sceptical propaganda. *BioSocieties* 8: 370-374.

Grundmann R and Scott M. (2014) Disputed climate science in the media: Do countries matter? *Public Understanding of Science* 23: 220-235.

Grundmann R and Stehr N. (2003) Social control and knowledge in democratic societies. *Science and Public Policy* 30: 183-188.

Gulbrandsen LH. (2008) The role of science in environmental governance: Competing knowledge producers in Swedish and Norwegian forestry. *Global Environmental Politics* 8: 99-122.

Ham C and Hill M. (1984) *The policy process in the modern capitalist state,* Hemel Hempstead: Wheatsheaf Books.

Hampel ML. (2014) Climate reconstruction and the making of authoritative scientific knowledge. *PhD thesis, Geography.* London: Kings College London.

Hoffman A. (2011) Talking past each other? Cultural framing of skeptical and convinced logics in the climate change debate. *Organization & Environment* 24: 3-33.

Horrigan JB. (2006) The internet as a resource for news and information about science. Washington D.C.: Pew Internet & American Life Project.

Hsu CL and Lin JCC. (2008) Acceptance of blog usage: The roles of technology acceptance, social influence and knowledge sharing motivation. *Information & Management* 45: 65-74.

Hulme M. (2009) *Why we disagree about climate change: Understanding controversy, inaction and opportunity,* Cambridge: Cambridge University Press.

Huntingford C and Fowler D. (2008) Climate change: Seeking balance in media reports. *Environmental Research Letters* 3: 021001.

Jacques PJ. (2012) A general theory of climate denial. *Global Environmental Politics* 12: 9-17.

Jankó F, Móricz N and Papp Vancsó J. (2014) Reviewing the climate change reviewers: Exploring controversy through report references and citations. *Geoforum* 56: 17-34.

Jasanoff S. (2004) *States of knowledge: The co-production of science and social order*. London: Routledge.

Jasanoff SS. (1987) Contested boundaries in policy-relevant science. *Social Studies of Science* 17: 195-230.

Kahan DM, Jenkins-Smith H and Braman D. (2011) Cultural cognition of scientific consensus. *Journal of Risk Research* 14: 147-174.

Kingdon J. (1995) *Agendas, alternatives, and public policies,* New York: Longman.

Livingstone D. (2003) *Putting science in its place: Geographies of scientific knowledge,* Chicago: University of Chicago Press.

Mahony M. (2014a) Climate change and the geographies of objectivity: The case of the IPCC's burning embers diagram. *Transactions of the Institute of British Geographers* 40: 153-167.

Mahony M. (2014b) The IPCC and the geographies of credibility. *History of Meteorology* 6: 95-112.

Martin B and Richards E. (1995) Scientific knowledge, controversy, and public decision-making In: Jasanoff S, Markle GE, Petersen JC, et al. (eds) *Handbook of science and technology studies.* Newbury Park, CA: Sage, 506-526.

Naylor R, Maye D, Ilbery B, et al. (2014) Researching controversial and sensitive issues: Using visual vignettes to explore farmers' attitudes towards the control of bovine tuberculosis in England. *Area* 46: 285-293.

Nisbet MC. (2011) Public opinion and political participation. In: Schlosberg D, Dryzek J and Norgaard R (eds) *Oxford handbook of climate change and society.* London: Oxford University Press, 355-368.

Nowotny H, Scott P and Gibbons M. (2001) *Re-thinking science: Knowledge and the public in an age of uncertainty,* Cambridge: Polity.

Nowotny H, Scott P and Gibbons M. (2003) Introduction: 'Mode 2' revisited: The new production of knowledge. *Minerva* 41: 179-194.

Painter J. (2011) *Poles apart: The international reporting of climate scepticism,* Oxford: University of Oxford.

Painter J and Ashe T. (2012) Cross-national comparison of the presence of climate scepticism in the print media in six countries, 2007-10. *Environmental Research Letters* 7: 044005.

Pelz D. (1959) The influence of anonymity on expressed attitudes. *Human Organization* 18: 88-91.

Pinch TJ. (2001) Scientific controversies. In: Smelser NJ and Baltes PB (eds) *International encyclopedia of the social & behavioral sciences.* Oxford: Pergamon, 13719-13724.

Pinch TJ and Bijker WE. (1984) The social construction of facts and artefacts: Or how the sociology of science and the sociology of technology might benefit each other. *Social Studies of Science* 14: 399-441.

Powell RC. (2007) Geographies of science: Histories, localities, practices, futures. *Progress in Human Geography* 31: 309-329.

Ravetz JR. (2011) 'Climategate' and the maturing of post-normal science. *Futures* 43: 149-157.

Ravetz JR. (2012) The significance of the Hamburg workshop: Post-normal science and the maturing of science *Nature and Culture* 7: 133-150.

Rittel HWJ and Webber MM. (1973) Dilemmas in a general theory of planning. *Policy Sciences* 4: 155-169.

Sarewitz D. (2004) How science makes environmental controversies worse. *Environmental Science & Policy* 7: 385-403.

Schäfer MS. (2012) Online communication on climate change and climate politics: A literature review. *Wiley Interdisciplinary Reviews: Climate Change* 3: 527-543.

Schmidt A, Ivanova A and Schäfer MS. (2013) Media attention for climate change around the world: A comparative analysis of newspaper coverage in 27 countries. *Global Environmental Change* 23: 1233-1248.

Spence A, Poortinga W and Pidgeon N. (2012) The psychological distance of climate change. *Risk Analysis* 32: 957-972.

Stehr N. (1994) *Knowledge societies,* Thousand Oaks, CA: Sage.

Stoll-Kleemann S, O'Riordan T and Jaeger CC. (2001) The psychology of denial concerning climate mitigation measures: Evidence from Swiss focus groups. *Global Environmental Change* 11: 107-117.

Suhay E and Druckman JN. (2015) The politics of science: Political values and the production, communication, and reception of scientific knowledge. *The ANNALS of the American Academy of Political and Social Science* 658: 6-15.

Suryanarayanan S and Kleinman DL. (2013) Be(e)coming experts: The controversy over insecticides in the honey bee colony collapse disorder. *Social Studies of Science* 43: 215-240.

Turnpenny JR. (2012) Lessons from post-normal science for climate science-sceptic debates. *Wiley Interdisciplinary Reviews: Climate Change* 3: 397-407.

van Eeten MJG. (1999) 'Dialogues of the deaf' on science in policy controversies. *Science and Public Policy* 26: 185-192.

Welch C, Marschan-Piekkari R, Penttinen H, et al. (2002) Corporate elites as informants in qualitative international business research. *International Business Review* 11: 611-628.

Whatmore SJ. (2009) Mapping knowledge controversies: Science, democracy and the redistribution of expertise. *Progress in Human Geography* 33: 587-598.

Williams HTP, McMurray JR, Kurz T, et al. (2015) Network analysis reveals open forums and echo chambers in social media discussions of climate change. *Global Environmental Change* 32: 126-138.

Wynn J and Walsh L. (2013) Emerging directions in science, publics, and controversy. *Poroi* 9: 1-5.

Young N and Matthews R. (2007) Experts' understanding of the public: Knowledge control in a risk controversy. *Public Understanding of Science* 16: 123-144.

Appendix A: Interview methodology

I.   Introduction

This methodological annex provides information on the interviews that contributed to Chapters 4, 5 and 6 of this thesis and is structured into three main parts:

1. An examination of the interview data collection process for Chapter 5 (on the impact of controversy on the production of scientific knowledge) and Chapter 6 (on the impact of climate controversy on policy decision-making), including the interview questions and the data collected;

2. A discussion of the methods used to analyse the interview data for Chapter 5 and Chapter 6; and,

3. A description of the interview data collection and data analysis processes for Chapter 4 (on why climate scientists and sceptical voices participate in the climate debate). Chapter 4 is discussed independently because it used a partially separate methodological process.

This annex aims to provide a fully transparent account of the methods used (Baxter and Eyles, 1997) for Chapters 4, 5 and 6 of this thesis that is balanced with the guarantees of anonymity provided to interview participants (detailed below). It is considered critical that deductive disclosure of individuals is avoided (Kaiser, 2009). Therefore, while detailed information on interview processes and data analysis is provided, information on participants is included solely in example or aggregate format. Interviews were carried out in two case study locations (as described in Section 1.2.1 in Chapter 1). Chapter 4 solely used interviews from the UK, and Chapters 5 and 6 used interviews from both case study locations. Where processes differed in each location (for example, with different interview protocols), it is identified in each section below.

II.   The data collection process for Chapters 5 and 6

This section describes the sample frame, recruitment process, ethical assurance and consent forms, temporal phasing and interview protocols for the interview research carried out for Chapters 5 and 6 of this thesis.

a. Actor groups

Based on an initial review of the literature on the phenomenon of "climate scepticism" (see for example Antilla, 2005; Carvalho, 2007; Malone, 2009; Hoffman, 2011), five key groups of actors who were involved in the climate change debate were identified as important contributors of knowledge to the specific research questions for Chapters 5 and 6:

Table A.6: Interview actor groups

Actor group	Rationale for inclusion (role in the climate change debate)
Climate scientist	Producers of climate change knowledge
Non-climate scientist academic	Those who study the contested climate change knowledge process
Other (e.g. media, industry representatives)	Those who interpret information or contribute to climate discourses
Policy official (i.e. civil servants)	Mediators and translators of knowledge into the policy-making process
Politician	Final decision-makers

It is important to note that these actor groups are not mutually exclusive—on the contrary, their boundaries are blurred. For example, policy officials in certain circumstances may also act as "final" decision-makers in the sense that they close down certain policy avenues and open up others. However, for the purposes of identifying relevant interviewees, formal employment role was prioritised. A further category of actors known as "sceptical voices" was also identified (see note 3 from Chapter 1 of this thesis on page 26). Sceptical voices were identified at the outset of this research as actors who create or disseminate dissenting viewpoints that either challenge mainstream climate science or the need to enact mitigation or adaption-based climate policies. This additional category of actor was overlaid on the five main actor groups as it was recognised that this categorisation by viewpoint was not mutually exclusive of formal employment role.

Interviewing the entire population of each of these actor groups in each case study location was beyond the scope of this research. Therefore, for each of the five actor groups, a sample frame of approximately 20 interviewees was identified, equating to approximately 100 interviews. This number was considered to be at the upper bounds of what was feasible for an individual research project of this scale and approach.

At the outset of the research the three actor groups of climate scientists, policy officials and politicians were deemed to be of a higher priority than certain other actor groups.

This was due to the focus of Chapter 5 on the impact of controversy on the production of scientific knowledge (specifically the actions of climate scientists), and the focus of Chapter 6 on the policy-making process. Groups that were considered of lower importance included non-climate scientist academics who were chosen largely for their ability to provide comment and discussion on the climate change debate in both case study locations. However, as anticipated at the outset of this research, obtaining interviews with politicians was problematic (Hertz and Imber, 1993) which influenced the relatively lower number of politicians interviewed. Twenty of the total number of interviews were conducted with those additionally categorised as sceptical voices. The final number of interviews per category is provided in the below table:

Table A.7: Interviews

Category	Description	NZ	UK	Total
Climate scientist	Scientists working on climate change in a university department of physics, geography, earth sciences or environment; or for a government-funded climate-related organisation	16	14	**30**
Non-climate scientist academic	Social scientists working on climate change or related issues	7	5	**12**
Other	Media, NGO or industry representatives	10	11	**22**
Policy official	Officials presently or previously working on climate change for state or city/regional-level policy departments, or independent policy advisory agencies	17	10	**27**
Politician	Sitting members of Parliament; political party spokespeople on climate change, environment or energy; or city/regional-level politicians	4	5	**9**
Total		54	45	**99***

* Including 20 interviewees classified as sceptical voices.

The below country-specific sections provide further detail on the organisations and other groups within which these interviewees were located. These include the major political parties and public-sector organisations responsible for climate change policy and science in each country, as well as well-known individuals publicly identified as sceptical voices. For example, interviews were obtained with individuals working for the UK Met Office and NIWA in NZ; key research centres for climate change science in each of the two case study countries. Access was also obtained with policy advisors in the Department for Energy and Climate Change (DECC) in the UK, and the Ministry for the Environment in NZ. These organisations are among the main bodies responsible for shaping, informing, and enacting public policy decisions regarding climate change in the UK and NZ.

Every effort was made to ensure that a representative sample of interviewees was obtained (for example, across different types of climate science or climate policy, or at different levels of seniority). However, as noted in the introduction above, a list of named individuals (or a list of all organisations to which interview participants belong) is not provided. Despite this research not involving vulnerable individuals (the subject of much of the research into anonymity and confidentiality in research interviews), given the very nature of this research topic as a public scientific controversy, it was considered especially important that anonymity was guaranteed to interview participants (Wiles et al., 2006). Providing named research sources would likely have compromised the willingness of certain interview participants to disclose information (particularly as regards whether or not they had been influenced by other actors within this controversy) and it was considered important to encourage responses that were as candid as possible. Given that guarantees of anonymity were given to interview participants, it is also critical that these continue to be honoured (BSA, 2002; Grinyer, 2002). Finally, while not uniquely attributed to named individuals, the generous use of direct quotes in the chapters of this thesis is intended to let the interview participants' voices speak "through" the analysis, and provide transparency to the reader within the recognised bounds of confidentiality and anonymity.

An initial list of potential interviewees of approximately 50 people was identified. This included well-known individuals, such as those who appear on Painter's 'list of sceptics 'mentioned' more than once in 10 UK national newspapers' (2011: 128) as identified in Note 3 in Section 6.9. It also included incumbent politicians responsible for climate change policy in each case study location. As noted above, the list additionally included organisations that were prominent in climate change science (such as the UK's Met Office and NZ's NIWA), in policy-making (such as the Department for Energy and Climate Change in the UK and the Ministry for the Environment in NZ), and those directly and specifically engaged in the climate change debate (such as the GWPF and the NZCSC). This list was collated from academic sources (such as from Painter (2011) as mentioned above), from named individuals and organisations frequently appearing in media articles, and from searching via other sources such as LinkedIn or publicly-available organisational charts (used predominantly for identifying policy officials).

b. Pilot interviews

An initial interview protocol (set of interview questions) of 12 pilot questions was created focusing largely on the issue of the impact of climate scepticism (given the initial focus of this research as explained in Chapters 1 and 7) and which were targeted predominantly at climate scientists. Nine individuals across the climate scientist and other actor categories were identified directly from the list above (five interviews) and via snowball sampling (four further interviews) to participate in these pilot interviews.

Snowball sampling was also used as the dominant method to identify further interviewees in all categories throughout the entire research process. This sampling method was chosen because of the difficulty of obtaining interviews within certain actor categories (such as with politicians as noted above). Obtaining direct introductions facilitated access to a greater number of interviewees than might otherwise have been possible. While this approach provides challenges in terms of potential bias (Baxter and Eyles, 1997), this was weighed against the need for access, particularly in terms of "hidden" populations such as lower-tier policy officials (Shaghaghi et al., 2011). The pilot interviews were conducted in the UK in November and December 2012. All but one of the interviews (conducted via Skype) were carried out face-to-face and lasted an average of 52 minutes. Four were conducted in Exeter, and the remainder were conducted in London.

c. Interview protocol

Subsequent to the pilot interviews, the question framework was further developed and five separate interview protocols were created. These interview protocols included a mix of questions from seven main categories as shown in the table below. The interviews were semi-structured based on these questions, although flexibility within each interview was considered important in order to pursue unexpectedly relevant responses. While some interviewees were unable to respond to every question asked, every effort was made to ensure that interviewees had, as far as possible, a clear understanding of the intent behind each question.

Table A.8: Interview framework categories

Category of question	Example question*	Actor group				
		Climate scientist	Non-climate scientist academic	Other	Policy official	Politician
Introductory	*Can you tell me about your job; what you do on a day-to-day basis?*	✓	✓	✓	✓	✓
Uncertainty and expertise	*How much certainty do you think is required when making policy decisions about climate change?*	✓	✓	✓	✓	✓
Climate scepticism	*How receptive do you think politicians are to information coming from those people labelled as 'climate sceptics'?*	✓	✓	✓		
Decision-making	*Where would you say your role fits in terms of the policy decision-making process to do with climate change in NZ/the UK?*		✓	✓	✓	✓
Personal opinion	*What do you personally think about climate change?*		✓	✓	✓	✓
Science	*How do you think scientific expertise on climate change is valued in NZ/the UK?*		✓	✓		
Information	*How do you get most of your information about climate change; and how do you determine its validity?*				✓	✓

* Note that the exact question used may be different to that presented here as each interview protocol (and thus the precise wording of each question) was specific to each actor category. The precise wording of each actual question asked in each interview also varied by interview.

For those identified as a sceptical voice, a further set of questions were developed as a separate interview protocol and which focused predominantly on questions related to perceptions of their impact on science and policy processes. For example, the following question, and follow-up questions, were included:

> *"1) Do you think that you are making an impact on the public discourse about climate change in NZ/the UK? a) What about on the decisions made by policy-makers, or the way climate science is done in this country? b) What precisely, giving concrete examples, would you say this impact consists of?"*

d. NZ interviews

Between January to April 2013, 54 interviews were conducted in NZ. Interviews lasted an average of 47 minutes. Six were conducted via Skype or telephone, with the remainder face-to-face. Three interviews were conducted jointly (face-to-face), with two individuals participating in each interview. Twenty one were conducted in Auckland, 30 were conducted in Wellington (or via Skype/telephone with Wellington-based individuals), with the remaining three interviews conducted with individuals located elsewhere in the country.

As with the pilot interviews, NZ interviews were identified firstly from the initial list of 50 interviewees (key individuals and organisations), then snowball sampling was used both in advance and whilst in NZ to organise additional interviews. Interviews occurred with individuals from public sector organisations such as the Ministry for the Environment, from the major political parties, from key science institutions such as NIWA and the University of Auckland, and with well-known sceptical voice organisations such as the NZCSC. As Table 8.2 shows, more interviews were carried out in NZ than in the UK. This was a factor of the ease through which snowball sampling yielded further interviews and the fact that message saturation in terms of receiving the same information from multiple different parties (Mason, 2010) occurred earlier in the UK interviews than in NZ.

For the pilot interviews and the NZ interviews, interviewees were verbally informed that they would be guaranteed anonymity as part of this research project. As noted above, this means that a list uniquely identifying interview participants is not provided as part of this annex. This is because by providing a list that is of value in terms of identifiable information would necessarily breach this guarantee of anonymity. For example, given the small nature of the interview population in NZ, providing the name of an organisation would easily identify the individual who would have been interviewed (as in many cases only one person works on the topic of climate change within an organisation). Interviewees were also informed that should the researcher wish to use a direct quote and there was any doubt whether the use of that direct quote would mean they would be able to be uniquely identified, they would be contacted to give their express permission. It was not considered that any direct quotes used in this thesis from the pilot or NZ interviews would directly identify any individual uniquely.

In March 2011, prior to the entire interview process commencing, the LSE's Research Ethics Review checklist[1] was completed and no ethical issues were identified. Subsequent to the NZ interviews, and in light of a freedom of information/subject access request in regards to another student's work, a decision was taken to further submit a Research Ethics Review Questionnaire to the LSE's Research Ethics Committee. The rationale was to verify that every aspect of the research conformed to the principles and best practice of ethical research. The committee agreed in July 2013 that appropriate ethical safeguards were in place. However, arising from this process and the issue related to the other student's work, a decision was also taken to use signed consent forms for the UK interviews. These consent forms are discussed in the following section.

e. UK interviews

Between August 2013 and May 2014, 35 further interviews were conducted with UK participants, with the final UK interview conducted in written format. Five were conducted via Skype or telephone, with the remainder face-to-face. All interviews were conducted individually and lasted an average of 55 minutes. 19 were conducted in London (face-to-face) with the remainder conducted with individuals in other parts of the UK such as Oxford, and one in Europe (the latter via Skype).

As with the UK, interviews were identified firstly from the initial list of 50 interviewees. Snowball sampling was subsequently used. This approach was especially important within the category of policy official because named individuals (and contact details in particular) were challenging to identify independently of interviewee recommendation. Interviews occurred with individuals from public sector organisations such as the Department of Energy and Climate Change, and the Department of Environment, Food and Rural Affairs, from the major political parties, from key science institutions such as the University of East Anglia and the Met Office, and well-known sceptical voice organisations such as the GWPF. As noted above, the UK interviews included the use of signed consent forms which provided written assurance of anonymity. Hence a list of interview participants is not provided as part of this annex. Also, as with the NZ interviews, interviewees were informed that should the

---

[1] See http://www.lse.ac.uk/intranet/researchAndDevelopment/researchDivision/policyAndEthics/ethicsGuidanceAndForms.aspx for the latest version of this guidance.

researcher wish to use a direct quote and there was any doubt whether the use of that direct quote would mean they would be able to be uniquely identified, they would be contacted to give their express permission. It was not considered that any direct quotes used in this thesis from the UK interviews would directly identify any individual uniquely.

III.   The data analysis process for Chapters 5 and 6

All 98 oral interviews[2] were transcribed verbatim. A naturalised transcription style (i.e. that which omits "ums" and "ers") was followed (Bucholtz, 2000); however, where false sentence starts were considered relevant to the content of the discussion, they were retained. All interviewees were given an option to receive a copy of their transcript and 11 interviewees made use of this option. Fourteen interviews were transcribed directly by the researcher, and the remainder were transcribed by third parties (who had signed confidentiality agreements) and were then double checked by the researcher to ensure accuracy.

All 99 transcripts were imported into NVivo and a largely inductive thematic coding process was followed (Fereday and Muir-Cochrane, 2006). Whereas certain codes were deductively identified based on the structure of the interview protocols (e.g. "uncertainty"), the majority were the result of a careful reading and re-reading of the interview transcripts. An extensive list of inductive codes was developed during a first round of analysis in NVivo. Where individual codes were identified as particularly relevant for answering the main research questions of each paper, the interview excerpts to which this code had been applied were exported from NVivo and subsequently hand-coded using paper and pen. For example, for Chapter 6, an important code within the NVivo analysis was "impact on policy". Interview excerpts to which this code had been applied were then printed out, and hand-coded used the coding structure of "yes", "no" and "indirect". This hand-coding was used to quantify elements within the transcripts (see for example Table 6.2 in Section 6.6 of Chapter 6). Hand-coding was used in order to get a closer appreciation of the text and to provide a different way of engaging with the research material (MacMillan, 2005).

---

[2] One interview was already in written format.

Hand-coding was also used to allow a more reflective way of engaging with the interview data. In Chapter 5, a key overarching deductive code identified in NVivo was "impact on scientists". These coded pieces of text from interviews with climate scientists were exported from NVivo and hand-coded to identify the types of impacts experienced. Each piece of text was examined to uncover firstly the impact on scientific practice (which was quantified using a yes/no categorisation system) and then further examined to inductively identify other types of impacts which were then iteratively honed into a typology of impact. The below table shows six examples (three from each case study) of the outcome of this process, including the categories used to identify impacts on scientific agency. These data were triangulated in two main ways: with the "impact on scientists" text coded within other interview transcripts, for example with non-climate scientist academics (data triangulation), and also with existing literature, such as the impacts identified by Kempner (2008) (methodological triangulation) (Farmer et al. 2006). While such triangulation methods do not eliminate bias, other methods such as the use of multiple coders (Hruschka et al., 2004) were unavailable. However, constant referral back to the original interview transcripts was employed to ensure selection bias on behalf of the researcher (e.g. in terms of choosing which excerpts to code) was minimised.

Table A.9: Example coding process for Chapter 5

Code	Impact of SV On own science		Other impact Other	Category of impact	
NZ Scientist 1	No	"They don't have an impact on how we *do* our science"	Yes	Greater focus on communication	**Greater focus on communication:** "...but they have an impact on what we think about and how we provide explanations for the science, the findings that emerge... I think what it's really turned the climate science community to is thinking about how we communicate climate science"
NZ Scientist 10	Yes	"Yes, I think it must do. The only simple answer to that question"	Yes	Delay; Defensive	**Delay:** "I don't think it stops response. I think that it becomes a delay in response because it easily creates that little addition to the problem, which is that there'll be these back-room discussions well, "Yeah, but so-and-so keeps saying this. We can't ignore can we? Maybe we need to be a bit more careful about...It just creates that bit of inertia" **Defensive:** "We're the climate scientists and people are attacking us, so we have become defensive, and we're in our tower and we're going to put out the walls around us"
NZ Scientist 11	No	"No" "...no it doesn't affect the way I do my work"	Yes	Greater focus on communication; Distraction; Certain types of SV can accelerate research	**Greater focus on communication:** "...that has an impact on how I communicate things. I go and read some of this stuff deliberately to find out what the thinking is" **Distraction:** "Some of the newspapers get letters to the editor quite often and I get contacted quite often by editors. Could you respond to this and that and the other thing. Yeah, you can spend your whole life doing tht kind of thing. It's strange really" **Can accelerate research:** "Some of the research that's been done by some of the more prominent climate scientists, sceptics, Dick Lindzen and so on, has induced other groups to do that kind of process. To do work. To look at whether their ideas are right. Follow up research, observational campaigns, the whole bit. So yeah, it has had an effect on the science, on the research effort, but not a huge effect" "It has certainly spurred some people into doing some things that may well have been done eventually, but have been accelerated"

Code	Impact of SV On own science		Other impact Other	Category of impact	
UK Scientist 4	No	"I don't think it's had any impact on the way *I* do science, no" "So from that perspective, the way I work *has* changed but only in responding to the climate sceptics. But the core part of my job I don't think has changed particularly because of climate sceptic views"	Yes	Awareness of being a target; Caution; Defensive; Reluctance to publicly engage; More transparency	**Awareness of being a target:** "I think the one thing about Climategate was that it made me realise, and up to then I didn't quite realise, how much pressure other scientists were under. And I think Climategate revealed that. If anything it revealed the amount of pressure that other scientists were being questioned about other things and the amount of insults and so on there were" **Caution:** "So if anything's different, I'm a little bit more cautious about how I communicate... I'll be a bit more careful about what I say but I don't try to hide anything or I don't make any effort to not say anything in emails because I'm worried that somebody might misconstrue it. No more than I would have normally I guess. I just try to be careful about making sure that everything I write is as clear as possible" **Defensive:** "it has made people a little bit more defensive... So you tend to be a little bit more cautious and I suspect the whole community in climate in particular are the same" **Reluctance to publicly engage:** "They may be a little bit more nervous especially about dealing with the media, are they going to be misinterpreted? Because certainly some media outlets are better than others as far as the way they interact with scientists and how they report what they say. That's always been the case but I think climate, because of the contention and the debate about various aspects of it, and the impacts, that you want to make sure you don't oversell the science or even undersell the uncertainties and so on" **More transparency:** "it seems to have focused people's minds more towards the sharing of data and enabling more open access to data whenever possible. Hopefully that would have been heading in that direction anyway, but I think it's made some people think, if we're going to do that anyway maybe we should push the agenda forward and try to do it sooner"

Code	Impact of SV On own science		Other impact Other	Category of impact	
UK Scientist 5	No	"I don't think on how I do science" "I don't think personally it's either made any difference to the way I do science or the way I'd advise a policymaker, because I do try and be sceptical"	Yes	Certain types of SV can accelerate research; Caution; More transparency; Defensive	**Certain types of SV can accelerate research:** "I'd rather spend time actually improving the science than chasing a whole lot of sceptical arguments which may or may not have any foundation. Unless if... I mean, some...somebody like Dick Lindzen, for example, particularly in the early days, made some very pertinent criticisms of modelling and some of things that we'd done, and if you look back you can... I can see where, along with my colleagues, we've responded to that. And that's been helpful" **Caution:** "It might change how I communicate them, and I...and I think one of the downsides is that, you know, particularly with Climategate and emails coming out, although I'd always be very careful what I wrote in emails anyhow! It does make you think twice because sometimes you'll just write something off and there's danger it can be misconstrued" **More transparency:** "one of the things we have tried to do is to make sure that where we can we have released the data and I think that's something that has improved" **Defensive:** "it has to some extent made me defensive"
UK Scientist 7	No	"Absolutely none" "They can write any crap they like about me and my science and The Sun and many of the papers have and it does not affect my day to day work at all because I'm a scientist and I do exactly what I do" "I think it affects *how* people interact with media and the public. I don't think that it influences how people do their science" "My viewpoint is that I don't think it has, I don't think it has a perceivable effect on how people do science"	Yes	Caution; Defensive; Greater focus on communication	**Caution:** "We're very, very careful about how we write press releases to make sure that, which unfortunately means that sometimes you're not quite as open as you could be" **Defensive:** "it means that you write them in a very defensive way, you make sure that all your press releases are written so that they cannot be misconstrued" **Greater focus on communication:** "I think it may have a perceivable effect on how people write up their science"

IV.   The interview process for Chapter 4

Chapter 4 is discussed separately in this annex as both the interview process and the data analysis differed slightly to that of Chapters 5 and 6. Twenty-two interviews were conducted for Chapter 4: 11 with sceptical voices and 11 with climate scientists. The 11 sceptical voice interviews overlapped with those of the sceptical voices identified in Table 8.2 above (they were conducted with the same individuals during the same interview, but used a separate interview protocol and consent process). These interviews were conducted by Ms Amelia Sharman. The 11 climate scientist interviews did not overlap with those of the climate scientists identified in Table 8.2 above (they were conducted with a separate list of individuals) and were conducted by Dr Candice Howarth from Anglia Ruskin University. Interviews occurred between September 2013 and February 2014 and lasted an average of 60 minutes.

Section 4.2 in Chapter 4 describes the interview themes, sources of interviewees, and analytical method (thematic and descriptive coding). Both the climate scientists and sceptical voices were asked the same questions from the same interview protocol. These included placing their opinion and that of a dominant other on the visual spectrum, commenting on whether they thought it was useful to be vocal about their point of view, and their opinions on labels used to categorise points of view within the climate change debate. As with the other UK-based interviews for Chapters 5 and 6, all 22 interviewees were provided with a consent form and were guaranteed anonymity. All were transcribed by a third party and checked by each interviewer to ensure accuracy.

The interviews were analysed using a two part process. First, broad thematic codes were deductively applied in NVivo using the interview protocol. These included codes such as "origin story" describing what inspired an interest in climate change and climate science, "own opinion rationale" describing what they saw as the rationale(s) behind their own opinion about climate change, and "experience of labelling" describing any incidences of times they have or have not been labelled within the climate change debate. Second, more specific analytical codes were inductively determined from the data and applied by hand to printed sections of interview text. These included "a-ha moment", "role of personal values" and "natural environment" underneath "origin story", and "has been labelled" and "hasn't been labelled" underneath "experience of labelling". Data were triangulated using interviewer triangulation, whereby each interviewer checked the application of codes across a

sample of the interviews conducted and analysed by the other author (Farmer et al., 2006).

V.   Conclusion

This annex has provided a detailed discussion of the interview methods and analytical approach for Chapters 4, 5 and 6 of this thesis. It has outlined the data collection process for the 99 interviews carried out in both case study locations (NZ and the UK) and across all three chapters. It has also described the analytical approaches taken, focusing largely on inductive and deductive thematic coding of interview transcripts.

VI.   References

Antilla L. (2005) Climate of scepticism: US newspaper coverage of the science of climate change. *Global Environmental Change* 15: 338-352.

Baxter J and Eyles J. (1997) Evaluating qualitative research in social geography: Establishing 'rigour' in interview analysis. *Transactions of the Institute of British Geographers* 22: 505-525

BSA. (2002) Statement of ethical practice for the British Sociological Association (March 2002). British Sociological Association: London. Available at: http://www.britsoc.co.uk/media/27107/StatementofEthicalPractice.pdf.

Bucholtz M. (2000) The politics of transcription. *Journal of Pragmatics* 32: 1439–1465.

Carvalho A. (2007) Ideological cultures and media discourses on scientific knowledge: Re-reading news on climate change. *Public Understanding of Science* 16: 223-243.

Farmer T, Robinson K, Elliott, SJ, et al. (2006) Developing and implementing a triangulation protocol for qualitative health research. *Qualitative Health Research* 16: 377-394.

Fereday J and Muir-Cochrane E. (2006) Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods* 5: 80-92.

Grinyer, A. (2002) The anonymity of research participants: Assumptions, ethics and practicalities, *Social Research Update*, Issue 36, Department of Sociology, University of Surrey.

Hertz R and Imber JB. (1993) Fieldwork in elite settings: Introduction. *Journal of Contemporary Ethnography* 22: 3-6.

Hoffman AJ. (2011). The culture and discourse of climate skepticism. *Strategic Organization* 9: 1-8.

Hruschka DJ, Schwartz D, Cobb St.John D, et al. (2004) Reliability in coding open-ended data: Lessons learned from HIV behavioral research. *Field Methods* 16: 307-331.

Kaiser K. (2009) Protecting respondent confidentiality in qualitative research. *Qualitative Health Research* 19: 1632-1641.

MacMillan K. (2005) More than just coding? Evaluating CAQDAS in a discourse analysis of news texts. *Forum: Qualitative Social Research* 6.

Malone EL. (2009) *Debating climate change: Pathways through argument to agreement*. London: Earthscan.

Mason, M. (2010) Sample size and saturation in PhD studies using qualitative interviews, *Forum: Qualitative Social Research* 11: Art. 8.

Shaghaghi A, Bhopal RS and Sheikh A. (2011) Approaches to recruiting 'hard-to-reach' populations into research: A review of the literature. *Health Promotion Perspectives* 1: 86-94.

Wiles R, Crow G, Heath S and Charles V. (2006) Anonymity and confidentiality. Paper presented at the ESRC Research Methods Festival, University of Oxford, July 2006.